



August 31, 2008

Mr. Jon Cherry  
General Manager  
Kennecott Eagle Minerals Company  
504 Spruce Street  
Ishpeming, MI 49849

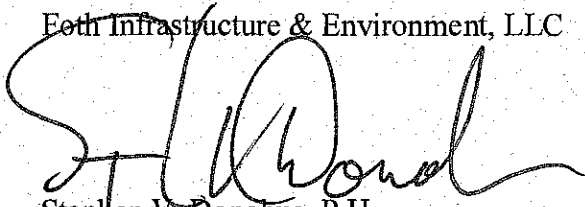
Dear Mr. Cherry,

Re: Humboldt Mill – Phase II Environmental Site Assessment Report

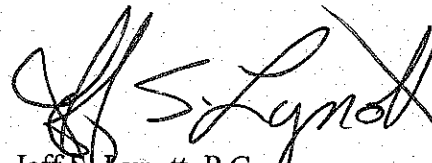
Enclosed for your distribution is the Humboldt Mill Phase II Environmental Site Assessment report.

Sincerely,

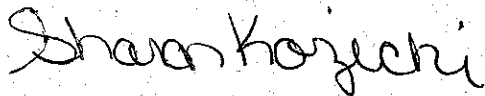
Foth Infrastructure & Environment, LLC



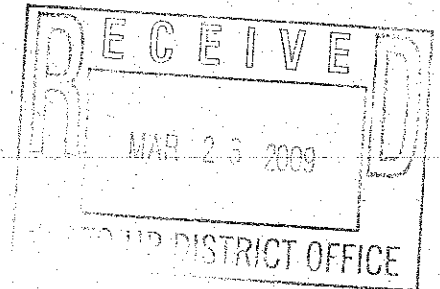
Stephen V. Donohue, P.H.  
Project Director



Jeff S. Lynott, P.G.  
Lead Geologist



Sharon V.F. Kozicki, P.G., C.E.M.  
Project Geologist



**Humboldt Mill**

**Phase II Environmental Site Assessment**

Project ID: 06W003

Prepared for  
**Kennecott Eagle Minerals Company**  
*ISO 14001:2004 Registered System*

Prepared by  
**Foth Infrastructure & Environment, LLC**

August 2008

**Foth Infrastructure & Environment, LLC 2008**

2737 South Ridge Road, Suite 600 • P.O. Box 12326 • Green Bay, WI 54307-2326 • (920) 497-2500 • Fax: (920) 497-8516

# Humboldt Mill

## Phase II Environmental Site Assessment

### Contents

	Page
1. Introduction.....	1
1.1 Purpose of the Phase II ESA.....	1
1.2 Areas of Concern Identified from the Phase I ESA.....	2
1.2.1 Office/Maintenance Building .....	2
1.2.2 Mill Building .....	3
1.2.3 Fuel Oil AST .....	3
1.2.4 Pyrite Stockpile Area.....	3
1.2.5 Buried Pyrite and Truck Scale Area.....	4
1.2.6 Septic Drainfield and Stormwater Outfall.....	4
1.2.7 Iron Ore Tailings Basins.....	4
1.2.8 Electrical Substation.....	4
1.2.9 PCB Transformers .....	4
1.2.10 Crusher Building.....	4
1.2.11 Iron Ore Concentrate .....	4
2. Regional Setting.....	5
2.1 Topography.....	5
2.2 Geology .....	5
2.3 Hydrology.....	7
2.3.1 Groundwater.....	7
2.3.2 Surface Waters.....	7
3. Historical Environmental Investigations.....	9
3.1 Overview of Past Work .....	9
3.1.1 Use of Historical Data .....	11
3.2 Summary of Soil Studies .....	11
3.2.1 Volatile Organic Compounds .....	11
3.2.2 Inorganics .....	12
3.2.3 Metals .....	12
3.2.4 PCBs.....	14
3.3 Summary of Groundwater Studies .....	14
3.3.1 Volatile Organic Compounds and Semi-Volatile Organic Compounds.....	14
3.3.2 Inorganics .....	14
3.3.3 Metals .....	15
3.4 Surface Water Studies .....	15
4. Methods of Investigation.....	16
4.1 Phase II Soil Investigations .....	16
4.1.1 Methodology.....	16
4.1.1.1 Drilling Methods.....	16
4.1.1.2 Deviations from Drilling Program .....	17
4.1.1.3 Handling of Field Investigation Wastes and Equipment Decontamination .....	18

## Contents (continued)

	Page
4.2 Groundwater Investigation .....	18
4.2.1 Methodology .....	19
4.2.1.1 Drilling Methods .....	19
4.2.1.2 Deviations from Drilling Program .....	19
4.2.1.3 Groundwater Monitoring Well Development and Sampling .....	20
4.3 Surface Water Investigations .....	22
4.3.1 Field Procedures .....	22
4.4 Investigation of Mill Buildings and Stockpiles .....	23
4.4.1 Stockpile Sampling .....	23
4.4.1.1 Methodology .....	24
4.4.2 PCB Sampling .....	26
4.4.2.1 Methodology .....	26
4.4.3 Other Materials Sampling .....	27
4.4.3.1 Methodology .....	27
4.5 Asbestos and Lead .....	27
4.5.1 Methodology .....	28
5. Results of Phase II .....	29
5.1 Geology and Hydrogeology .....	29
5.1.1 Geology .....	29
5.1.1.1 Geotechnical Results .....	30
5.1.2 Groundwater Flow .....	30
5.1.3 Surface Water Flow .....	31
5.2 Soil Analytical Results .....	31
5.2.1 Volatile Organic Compounds and Polynuclear Aromatic Hydrocarbons .....	31
5.2.2 Inorganics .....	32
5.2.3 Metals .....	32
5.3 Groundwater Analytical Results .....	35
5.3.1 Volatile Organic Compounds .....	35
5.3.2 Inorganics .....	35
5.3.3 Metals .....	36
5.4 Surface Water Analytical Results .....	38
5.4.1 Metal Concentrations in Surface Water .....	38
5.4.2 Sedimentation Evaluation and Groundwater Surface Water Interface Protection Criteria .....	39
5.4.2.1 Sediment Evaluation .....	39
5.4.2.2 Groundwater Surface Water Interface Protection Criteria - Groundwater .....	39
5.5 Mill Analytical Results .....	39
5.5.1 Stockpile Sampling Results .....	39
5.5.2 PCB Sampling Results .....	41
5.5.3 Buried Pyrite Area Sampling Results .....	42
5.6 Asbestos and Lead Inspection Results .....	43
6. Conclusions .....	44
6.1 Shop Office Area .....	45
6.2 Mill Buildings .....	45
6.3 Fuel Oil AST .....	46
6.4 Pyrite Stockpile Area .....	46

## **Contents (continued)**

	Page
6.5 Buried Pyrite and Truck Scale Area.....	46
6.6 Septic Drainfield and Stormwater Outfall.....	47
6.7 Iron Ore Tailings Basins.....	47
6.8 Electrical Substation.....	47
6.9 PCB Transformers.....	47
6.10 Crusher Building.....	47
6.11 Iron Ore Concentrate.....	47
6.12 Asbestos and Lead Assessment.....	48
7. References.....	49

### **Tables**

(Located after Tables tab)

Table 3-1	Mill Area Historical Soil Results - Exceedances
Table 3-2	Mill Area Historical Groundwater Results - Exceedances
Table 3-3	Mill Area Historical Surface Water Results - Exceedances
Table 4-1	Well Construction and Soil Boring Details
Table 4-2	Soil Analytical Program Summary
Table 4-3	Groundwater Monitoring Program Summary
Table 4-4	Water Truck Sample Results
Table 4-5	Groundwater Quality Monitoring Program Inorganic Parameter List
Table 4-6	Groundwater Quality Monitoring Program Volatile Organic Compounds Parameter List
Table 4-7	Groundwater Quality Monitoring Program Polynuclear Aromatic Hydrocarbon Parameter List
Table 4-8	Surface Water Quality Monitoring Program Parameter List
Table 4-9	Sediment Quality Monitoring Program Parameter List
Table 4-10	Mill Building Analytical Parameters
Table 4-11	Description of Stockpile Samples
Table 5-1	2006 Soil Results - Exceedances
Table 5-2	November 2006 Groundwater Results - Exceedances
Table 5-3	August and October 2006 Surface Water Results - Exceedances
Table 5-4	2006 Sediment Analytical Results - Exceedances
Table 5-5	Groundwater Results Exceedances - Compared to GSI

### **Figures**

(Located after Figures tab)

Figure 1-1	Project Location
Figure 1-2	Site Location
Figure 1-3	Watershed Boundary
Figure 1-4	Location of External Recognized Environmental Conditions
Figure 1-5	Project Site Existing Conditions and Structures
Figure 2-1	Regional Area Existing Conditions

## Contents (continued)

---

Figure 2-2	Bedrock Geology
Figure 2-3	Generalized Geologic Cross-Section
Figure 3-1	Historical Soil Sample Locations
Figure 3-2	Historical Soil Sample Locations 1,2,4 - Trimethylbenzene in Soil
Figure 3-3	Historical Soil Sample Locations Anthracene in Soil
Figure 3-4	Historical Soil Sample Locations Phenanthrene in Soil
Figure 3-5	Historical Soil Sample Locations Cyanide in Soil
Figure 3-6	Historical Soil Sample Locations Antimony in Soil
Figure 3-7	Historical Soil Sample Locations Arsenic in Soil
Figure 3-8	Historical Soil Sample Locations Iron in Soil
Figure 3-9	Historical Soil Sample Locations Manganese in Soil
Figure 3-10	Historical Soil Sample Locations Nickel in Soil
Figure 3-11	Historical Soil Sample Locations Silver in Soil
Figure 3-12	Historical Soil Sample Locations Chromium in Soil
Figure 3-13	Historical Soil Sample Locations Lead in Soil
Figure 3-14	Historical Soil Sample Locations Magnesium in Soil
Figure 3-15	Historical Groundwater Sampling
Figure 3-16	Historical Groundwater Sampling – Benzene
Figure 3-17	Historical Groundwater Sampling – Ethylbenzene
Figure 3-18	Historical Groundwater Sampling – Xylenes
Figure 3-19	Historical Groundwater Sampling – 2-Methylnaphthalene
Figure 3-20	Historical Groundwater Sampling – Acenaphthylene
Figure 3-21	Historical Groundwater Sampling – Naphthalene
Figure 3-22	Historical Groundwater Sampling – Phenanthrene
Figure 3-23	Historical Groundwater Sampling – Nitrogen/Ammonia
Figure 3-24	Historical Groundwater Sampling – Sulfate
Figure 3-25	Historical Groundwater Sampling – Arsenic
Figure 3-26	Historical Groundwater Sampling – Iron
Figure 3-27	Historical Groundwater Sampling – Lead
Figure 3-28	Historical Groundwater Sampling – Manganese
Figure 3-29	Historical Groundwater Sampling – Cadmium
Figure 3-30	Historical Groundwater Sampling – Nickel
Figure 3-31	Historical Groundwater Sampling – Chromium
Figure 3-32	Historical Groundwater Sampling – Sodium
Figure 3-33	Historical Surface Water Sampling – Arsenic
Figure 3-34	Historical Surface Water Sampling – Mercury
Figure 3-35	Historical Surface Water Sampling – Silver
Figure 3-36	Historical Surface Water Sampling – Zinc
Figure 4-1	Soil Boring, Monitoring Well and Staff Gauge Locations
Figure 4-2	Surface Water Sample Locations
Figure 4-3	Mill Building Sample Locations
Figure 5-1	Surficial Geology
Figure 5-2	Boring/Well/Geologic Cross Section Locations
Figure 5-3	Geologic Cross Sections A-A' and E-E'
Figure 5-4	Geologic Cross Sections B-B' and D-D'
Figure 5-5	Geologic Cross Sections C-C', Q-Q' and R-R'
Figure 5-6	Geologic Cross Section F-F'
Figure 5-7	Geologic Cross Sections G-G' and H-H'
Figure 5-8	Geologic Cross Section I-I'

## Contents (continued)

---

Figure 5-9	Geologic Cross Section J-J'
Figure 5-10	Geologic Cross Section K-K'
Figure 5-11	Geologic Cross Section L-L'
Figure 5-12	Geologic Cross Section M-M'
Figure 5-13	Geologic Cross Section N-N'
Figure 5-14	Geologic Cross Section O-O'
Figure 5-15	Geologic Cross Section P-P'
Figure 5-16	Historical Aerial Photos
Figure 5-17	Groundwater Contours Nov. 2006
Figure 5-18	Soil Sample Locations 1,2,4, - Trimethylbenzene in Soil
Figure 5-19	Soil Sample Locations 1,3,5, - Trimethylbenzene in Soil
Figure 5-20	Soil Sample Locations N-Propylbenzene in Soil
Figure 5-21	Soil Sample Locations S-Butylbenzene in Soil
Figure 5-22	Soil Sample Locations Naphthalene in Soil
Figure 5-23	Soil Sample Locations Anthracene in Soil
Figure 5-24	Soil Sample Locations Phenanthrene in Soil
Figure 5-25	Soil Sample Locations Cyanide in Soil
Figure 5-26	Soil Sample Locations Aluminum in Soil
Figure 5-27	Soil Sample Locations Cobalt in Soil
Figure 5-28	Soil Sample Locations Iron in Soil
Figure 5-29	Soil Sample Locations Manganese in Soil
Figure 5-30	Soil Sample Locations Antimony in Soil
Figure 5-31	Soil Sample Locations Arsenic in Soil
Figure 5-32	Soil Sample Locations Boron in Soil
Figure 5-33	Soil Sample Locations Lithium in Soil
Figure 5-34	Soil Sample Locations Magnesium in Soil
Figure 5-35	Soil Sample Locations Molybdenum in Soil
Figure 5-36	Soil Sample Locations Lead in Soil
Figure 5-37	Soil Sample Locations Nickel in Soil
Figure 5-38	Soil Sample Locations Selenium in Soil
Figure 5-39	Soil Sample Locations Silver in Soil
Figure 5-40	Soil Sample Locations Thallium in Soil
Figure 5-41	Soil Sample Locations Zinc in Soil
Figure 5-42	Monitoring Well Locations Benzene in Groundwater Nov. 2006
Figure 5-43	Monitoring Well Locations Ethylbenzene in Groundwater Nov. 2006
Figure 5-44	Monitoring Well Locations Xylenes in Groundwater Nov. 2006
Figure 5-45	Monitoring Well Locations Nitrogen/Ammonia in Groundwater Nov. 2006
Figure 5-46	Monitoring Well Locations Sulfate in Groundwater Nov. 2006
Figure 5-47	Monitoring Well Locations Iron in Groundwater Nov. 2006
Figure 5-48	Monitoring Well Locations Manganese in Groundwater Nov. 2006
Figure 5-49	Monitoring Well Locations Aluminum in Groundwater Nov. 2006
Figure 5-50	Monitoring Well Locations Arsenic in Groundwater Nov. 2006
Figure 5-51	Monitoring Well Locations Cobalt in Groundwater Nov. 2006
Figure 5-52	Monitoring Well Locations Vanadium in Groundwater Nov. 2006
Figure 5-53	Monitoring Well Locations Beryllium in Groundwater Nov. 2006
Figure 5-54	Monitoring Well Locations Cadmium in Groundwater Nov. 2006
Figure 5-55	Monitoring Well Locations Chromium in Groundwater Nov. 2006
Figure 5-56	Monitoring Well Locations Copper in Groundwater Nov. 2006
Figure 5-57	Monitoring Well Locations Lithium in Groundwater Nov. 2006

## **Contents (continued)**

Figure 5-58	Monitoring Well Locations Nickel in Groundwater Nov. 2006
Figure 5-59	Monitoring Well Locations Zinc in Groundwater Nov. 2006
Figure 5-60	Surface Water Sample Locations Manganese in Surface Water August 2006
Figure 5-61	Surface Water Sample Locations Mercury in Surface Water August 2006
Figure 5-62	Surface Water Sample Locations Nickel in Surface Water August 2006
Figure 5-63	Surface Water Sample Locations Silver in Surface Water October 2006
Figure 5-64	Surface Water Sample Locations Mercury in Surface Water August 2006
Figure 5-65	Surface Water Sample Locations Zinc in Surface Water October 2006
Figure 5-66	Surface Water Sample Locations Arsenic in Sediment August 2006
Figure 5-67	Surface Water Sample Locations Chromium in Sediment August 2006
Figure 5-68	Surface Water Sample Locations Cobalt in Sediment August 2006
Figure 5-69	Surface Water Sample Locations Copper in Sediment August 2006
Figure 5-70	Surface Water Sample Locations Lead in Sediment August 2006
Figure 5-71	Surface Water Sample Locations Nickel in Sediment August 2006
Figure 5-72	Surface Water Sample Locations Silver in Sediment August 2006

## **Appendices**

### **Appendix A - Historical Data**

- A-1 Historical Soil Results
- A-2 Historical Groundwater Results
- A-3 Historical Surface Water Results November 7, 1995
- A-4 Tier 1 Historical Data
- A-5 Tier 2 Historical Data
- A-6 Tier 3 Historical Data
- A-7 Historical Boring Logs

### **Appendix B Phase II Soil Investigation Field Data**

- B-1 Boring and Well Logs
- B-2 Drillers Logs, Well Development Record, and Boring Abandonment Logs
- B-3 Geotechnical Soil Reports
- B-4 Slug Test Results

### **Appendix C MDEQ RRD Operational Memo #2, Attachment 5**

### **Appendix D Soil Sampling**

- D-1 Soil Analytical Results
- D-2 Laboratory Analytical Reports

### **Appendix E Groundwater Sampling**

- E-1 NJC Field Reports
- E-2 Groundwater Results Summary
- E-3 Laboratory Analytical Reports

### **Appendix F Surface Water and Sediment Sampling Results**

- F-1 NJC Field Reports
- F-2 Surface Water Field and Analytical Summary Tables
- F-3 Sediment Analytical Results - Compared to Groundwater Surface Water Interface
- F-4 Laboratory Analytical Reports

### **Appendix G Mill Building Investigation**

- G-1 Analytical Methods and Method Detection Limits



## **Contents (*continued*)**

---

G-2	Field Logs
G-3	Analytical Results
G-4	Laboratory Analytical Reports
G-5	Asbestos Report
G-6	Lead Report

# Humboldt Mill

## Phase II Environmental Site Assessment

### List of Abbreviations, Acronyms, and Symbols

---

ACM	Asbestos Containing Material
AST	Aboveground storage tank
ASTM	American Society for Testing and Materials
BEA	Baseline Environmental Assessment
bgs	Below Ground Surface
°C	degrees Celsius
CCI	Cleveland Cliffs, Inc.
cfr	Code of Federal Regulations
cm <sup>2</sup>	Square Centimeters
COC	Chain-of-Custody
DCC	R 299.5746 Direct Contact Criteria
DO	dissolved oxygen
DWC	R 299.5744 Residential Groundwater Drinking Water Criteria
DWPC	R 299.5746 Soil Drinking Water Protection Criteria
EPA	United States Environmental Protection Agency
ESA	Environmental Site Assessment
ESL	Ecological Screening Level
ft	feet
Foth	Foth Infrastructure & Environment, LLC
GPS	Global Positioning System
GSIPC	Groundwater Surface Water Interface Protection Criteria
HSA	Hollow Stem Auger
HTDF	Humboldt Tailings Disposal Facility
HUD	Housing and Urban Development
ID	identification
KEMC	Kennecott Eagle Minerals Company
MDEQ	Michigan Department of Environmental Quality
Maxim	Maxim Technologies, Inc.
mg/kg	milligrams/kilogram
mg/l	milligrams/liter
Mill	Humboldt Mill
MPC	Minerals Processing Corporation
MSL	Mean Sea Level
NJC	North Jackson Company
NREPA	National Resources and Environmental Protection Act, 1994 PA 451, as Amended
No.	number
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated biphenyl
PEC	Probable Effect Concentration
ppm	Parts per million
PVC	polychlorinated biphenyl
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Check

## List of Abbreviations (*con't*)

RCRA	Resource Conservation and Recovery Act
RECs	Recognized Environmental Conditions
RRD	Remediation and Redevelopment Division
SCA	Sundberg, Carlson and Associates, Inc.
SPT	Standard Penetration Testing
SPLP	Synthetic Precipitation Leaching Procedure
TCLP	Toxicity Characteristic Leaching Profile
TES	Traverse Engineering Services, Inc.
ug/kg	micrograms/kilogram
ug/l	micrograms/liter
US	United States
USGS	United States Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
XRF	X-ray Fluorescence

## **1. Introduction**

On behalf of Kennecott Eagle Minerals Company (KEMC), Foth Infrastructure & Environment, LLC (Foth) performed a Phase II Environmental Site Assessment (Phase II ESA) for the Humboldt Mill (Mill) located at 4567 County Road 601, Marquette County, Michigan and adjacent property that was once part of the Cleveland Cliffs, Inc. (CCI) operations and Callahan Mining operations (Project Site). This report presents the results of the Phase II Investigation. The Project Site is located in Humboldt Township, Marquette County, Michigan about 24 miles west of the City of Marquette (Figure 1-1). Major highways leading to the Project Site include State Highway 95, located approximately one mile to the west and US 41/State Highway 28, located approximately one mile to the north. Access to the Mill is from County Road 601, which intersects State Highway 95.

The terrain of western Marquette County can be characterized as low areas, comprised of lakes, streams, wetlands and isolated sand plains, separated by rugged, bedrock-supported ridges (Figure 1-2). Regional surface water drainage in the area is controlled by topography and bedrock outcroppings. In the area of the mill surface water drains into small creeks and rivers that flow through the wetland. Surface water drainage is generally to the south entering the Escanaba or Black River. The Black River is a tributary of the Escanaba River. Figure 1-3 displays the regional drainage system and watersheds. The Middle Branch of the Escanaba River drains the northern half of the subject site that includes the existing Humboldt Tailings Disposal Facility (HTDF), then turns to the southeast flowing to Lake Michigan. Approximately 1.5 mile southwest of the site, Mud Lake empties into what is referred to in this report as the West Branch of the Black River, which flows through Iron Ore Tailings Basin West before turning south to enter the Main Branch of the Black River, south of the Project Site. The iron tailings ponds situated southeast of the mill do not currently have a surface outflow. However, if the surface elevations of those ponds were higher, both would drain to Lake Lory. The outlet of Lake Lory drains into the Black River, which flows to the southwest, then to the southeast before it empties into the Middle Branch of the Escanaba River.

Isolated, flooded wetlands can be found on the ridge in the northern portion of the Project Site, east of the former pellet plant, and south of the mill buildings. The flooded wetland south of the mill flows to the west in what appears to be a man-made ditch, eventually flowing into the West Branch of the Black River. The Mill Site is located in a relatively low area bordered on the north by a steep ridge with many bedrock outcrops.

The Phase I ESA (Foth, 2007), was completed per American Society for Testing and Materials (ASTM) standards and identified recognized environmental conditions (RECs), and several de minimis conditions. RECs are conditions where the findings indicate that there is a potential for a release of hazardous materials to the environment, or that a release has occurred. De minimis conditions are those situations that do not indicate a current material risk of harm to public health or the environment.

### **1.1 Purpose of the Phase II ESA**

The purpose of a Phase II ESA is to determine the presence or absence of hazardous substances related to the RECs identified in the Phase I ESA (Foth, 2007). This report documents the activities that have been conducted to evaluate the RECs that were identified in the Phase I ESA. This evaluation encompasses field and laboratory analysis of soils, groundwater, surface water

and other media on the Project Site and the surrounding area. This report presents data related to each REC. As such, the scope of work of the Phase II ESA included the following:

- ♦ Geologic investigation of the potential areas of concern,
- ♦ Collection and analysis of soil samples from selected locations via soil borings,
- ♦ Collection and analysis of groundwater samples from monitoring wells,
- ♦ Collection of surface water and sediment samples, at and surrounding the Project Site,
- ♦ Asbestos survey of facility,
- ♦ Lead paint survey, and
- ♦ Collection of additional samples of materials within and around the mill facility.

## **1.2 Areas of Concern Identified from the Phase I ESA**

Given the aerial extent of the Project Site and the number of RECs identified in the Phase I ESA, the RECs have been grouped into areas of concern, as displayed on Figure 1-4. Figure 1-5 displays a planimetric map of the subject site and existing topographic conditions and structures. Sections 1.2.1 through 1.2.11 summarize the areas of concern that were identified in the Phase I ESA and were investigated and are reported on in this Phase II ESA. Note that this Phase II ESA does not address investigations of the HTDF that KEMC plans to use as a tailings disposal facility since KEMC is not seeking liability protection for this facility.

### **1.2.1 Office/Maintenance Building**

The office/maintenance building includes office space, a laboratory and the vehicle maintenance shop. Gasoline and diesel fuel were stored in underground storage tanks (USTs) near the northeast corner of this building and vehicle maintenance took place in the western half of the building. RECs in this area include:

- ♦ A remediated leaking UST site, containing fuel oil, diesel and gasoline USTs, is located north of the building and has not been closed.
- ♦ A hydrocarbon release was identified in the area just west and south of the maintenance shop area. The source for these hydrocarbons could be mismanagement of waste oil in the shop area.
- ♦ Oil stains on the vehicle maintenance shop floor and the presence of floor drains and cracks in the floor.
- ♦ Containers of lab assay waste were noted in the lunchroom. Rainwater has leaked into the area and caused fiber drums to deteriorate and cause staining on the floor.
- ♦ Due to the age of the facility, there is a potential for lead-based paint to be present inside the buildings. The facility does not have documentation to demonstrate that paints do not contain lead. Peeling paint is evident on the interior of the office area.
- ♦ Sources of suspect asbestos-containing materials (ACM) that were observed during the Phase I site visit and include floor and ceiling tile in office areas, insulation in boiler areas and piping used to transfer steam to the flotation circuit.

### **1.2.2 Mill Building**

The mill building is the largest building on the property. This building is located between the office/maintenance building and the remains of the taconite pellet plant. RECs in this area include:

- ♦ Oil staining was observed on the floor in the motor control centers in the mill building.
- ♦ An aboveground storage tank (AST) located inside the building, along the east wall contains water with a layer of oil.
- ♦ A brown, congealed material was noted on the outside walls of one of the interior offices in the mill building.
- ♦ An AST located outside of the southeast corner of the mill building has released finely ground pyrite material on to the lower floor of the mill building. This material has spread to the south wall. There is also yellow staining on the ground outside the building where the siding meets the ground. This material may contain hazardous substances of concern.
- ♦ There are numerous piles or open containers of former process materials stored at several locations within the building. Other materials include remaining mill reagents and laboratory chemicals. It is believed most of these materials will be managed by selling the materials directly to an interested party, recycling or disposal at an appropriate facility.
- ♦ There is an accumulation of debris both within the mill building complex and around the perimeter. Debris includes such items as used equipment, metal debris, empty steel drums, refractory material and insulation.

### **1.2.3 Fuel Oil AST**

During the site inspection, Foth investigators observed a sandy area, with sparse vegetation, surrounded by a rectangular berm, to the east of the pellet plant. Review of the historic aerial photographs of the Project Site revealed a large AST situated adjacent to the east side of the former taconite pellet plant.

### **1.2.4 Pyrite Stockpile Area**

This area is located immediately south of the mill building. It was used for storage of process materials.

Pyritic gold ore, gold-bearing pyrite concentrate, and pyrite leach residue were stockpiled south of the mill building and office/maintenance areas. Previous environmental investigations (Sundberg, Carlson and Associates, [SCA] 1996) identified this area as a source of metal concentrations in groundwater.

Dissolved metals were also identified in groundwater samples collected in this area in past environmental investigations. Some of the samples from this area identified groundwater with metal concentrations that could be of regulatory significance.

Past surface water samples obtained from this area also contained metal concentrations that could be of regulatory significance.

#### **1.2.5 Buried Pyrite and Truck Scale Area**

Pyritic flotation concentrate was buried in a trench, north of the main access road to the Mill. It was noted during the Phase I ESA that yellow-orange staining of the paved roadway adjacent to the pyrite trench has occurred. Some of the vegetation on the other side of the roadway appears to be stressed. Historic samples of soil collected from this location identified concentrations of several metals that could be of regulatory significance. Elevated concentrations of metals at the truck scale area that could be of regulatory significance were also noted in historic soil samples.

#### **1.2.6 Septic Drainfield and Stormwater Outfall**

Based on historical records and interviews with the current property owner, the floor drains were connected to the sanitary sewer which discharged into a drain field south of the Mill. During the field inspection, a storm water or process water outfall was identified which formerly discharged into a wetland adjacent to the septic field. It is unknown whether this discharge point originated from stormwater runoff in the vicinity of the mill, the office and maintenance shop or both.

#### **1.2.7 Iron Ore Tailings Basins**

Two large iron ore tailings storage facilities are located approximately 1,400 ft southeast of the mill building. These facilities may be characterized as monofills of relatively inert material, the actual environmental impact to the groundwater and surface water is unknown.

#### **1.2.8 Electrical Substation**

The absence of polychlorinated biphenyls (PCBs) has not been verified at the electrical substation located above the mill buildings. Old PCB warning labels are still affixed to the outside doors, but the doors are still locked. Evidence of spills and/or leaks was not observed during the Phase I inspection.

#### **1.2.9 PCB Transformers**

The Project Site formerly had several PCB containing transformers on-site that were removed and disposed. Previous sampling (SCA, 1996) has shown evidence of PCB contamination in three areas within the mill building where transformers were located.

#### **1.2.10 Crusher Building**

Drums of grit blast waste in the crusher building may also be characterized as hazardous waste. There are also numerous piles and other closed containers of process material stored within the building.

#### **1.2.11 Iron Ore Concentrate**

There are two piles of iron ore concentrate located south of the mill building. These piles are identified on Figure 1-4.

## **2. Regional Setting**

### **2.1 Topography**

The Project Site is located in the Humboldt Township, in western Marquette County (Figure 1-2). The area is characterized by rugged bedrock ridges, separated by sand plains, wetlands and lakes. The highest elevation in the vicinity can be found on the ridge in the north half of Section 11, T47N, R29W, approximately 1,760 ft above mean sea level. The lowest elevation, 1,558 ft above mean sea level, occurs at the HTDF, which bisects the ridge in the north half of Section 11. Most of the land around the mill buildings has been raised up to the existing grade, to produce a generally flat, south sloping surface, approximately 1,600 ft above mean sea level (Figure 2-1).

To the northwest of the mill buildings is a large, water-filled former open pit iron mine used for storage of Ropes Mine tailings, known as the HTDF. East of the HTDF lies a small mined out iron ore pit, that may be water-filled during the spring and extended wet periods, but is otherwise dry. Lean iron ore and development rock taken from the former Humboldt Mine is stored in two separate locations, forming flat-topped hills that rise up to 150 ft above the existing terrain. One is located adjacent to the northwest edge of the HTDF and the other is located southwest of the HTDF (Figure 2-1). Tailings produced from the processing of iron ore have been deposited in topographic depressions to the east and west of the Mill, forming broad, south sloping plains. The tailings basins southeast of the mill buildings are surrounded by man-made stone berms, constructed between isolated upland areas.

### **2.2 Geology**

The Project Site is located in the western half of the Upper Peninsula dominated by Precambrian Rocks covered by a variable thickness of unconsolidated glacial sediments. The former Humboldt Mine is located in the Marquette Range, a mining district more than 25 miles long. Iron ore has been mined in this district for more than 160 years. In addition to iron, there are more than 20 known metal occurrences north of the Marquette Range, in an area known as the Northern Complex.

Lead, zinc and silver veins are most common. There are also many gold occurrences in the Northern Complex, some of which have been mined in the past. Other trace metals commonly occur with these deposits and they may be locally abundant, including antimony, boron, copper, molybdenum, silver and nickel.

The geology of the former Humboldt Mine and area of the Mill, shown in Figure 2-2, was mapped in detail by the United States Geological Survey (U.S.G.S.) in 1975 as part of the Republic Quadrangle (Cannon, 1975). Bedrock in this area consists of Archean granitic gneiss in fault contact with younger, Lower Proterozoic sediments intruded by diabase dikes and sills that have been folded and metamorphosed. The metamorphosed sedimentary and intrusive rocks form the highest ridges. The rocks include quartzite, iron formation, minor slate and the intruded diabase, that are complexly folded, but generally form an anticline which plunges to the west and hosts the iron ore deposit that was mined from the Humboldt Pit that forms the HTDF.

The stratigraphy in the vicinity of the Humboldt Pit consists of the Negaunee Iron formation divided into a thin, upper hematite-rich oxide facies and a lower, thicker cherty silicate iron



formation. Both units are generally evenly bedded, recrystallized and may display a strong foliation. The iron formation is unconformably overlain by the Goodrich quartzite, which, in the HTDF consists predominantly of thick lenses of basal conglomerate. Clasts in the conglomerate range from angular to sub rounded iron formation and other sedimentary rocks, along with well rounded pebbles and cobbles of vein quartz. The matrix is completely silicified and is dominated by fine grained quartz with accessory muscovite, hematite and magnetite with little or no feldspar. Both have been intruded by a medium to coarse grained diabase that generally forms concordant masses. All of these rocks were then folded and metamorphosed, and contacts between the intrusive rocks and iron formation were commonly sheared. This folded sequence forms a prominent east-west ridge through the northern portion of the Project Site that rises more than 200 ft above the lowlands to the north and south and generally forms an anticline that plunges to the west.

The deformation and foliation of these rocks has served to produce a weakly jointed bedrock surface. Sheared and recrystallized contacts at depth would likely limit joint propagation. Typically, recrystallized formations without a well developed joint network would be very poor groundwater producers.

The bedrock is overlain by a complex sequence of unconsolidated glacial and post glacial material that is generally thinner over the bedrock ridges and thicker in the adjacent valleys. Differential erosion at the contact between the iron formation and quartzite produced a narrow pass that cut across the prominent east-west trending ridge. At the end of the last glaciation, this ridge acted as a dam, inhibiting the flow of glacial meltwater southward. The pass localized a post-glacial stream channel that enhanced this valley and deposited wedges of alluvial sediments at the north and south ends of the valley. Till and outwash are the most common unconsolidated formations. Peat and lacustrine deposits underlie in the area of the Mill. Both are generally thinner over the ridge and thicker where it occurs in the valleys.

Figure 2-3 shows a generalized geologic cross section of the Project Site. The former Humboldt Mine was developed in a post-glacial stream channel that cut through the bedrock ridge. Previous subsurface environmental investigations (SCA, 1992, 1996) have documented the presence of a buried swamp, or wetland in the area south of the mill buildings. According to these reports, this area was backfilled to facilitate construction of the Mill.

Iron mining at the former Humboldt Mine created a pit approximately 350 feet (ft) deep. While the mine was operating, stormwater and groundwater that entered the pit was removed by pumping. After mining ceased, groundwater and surface water was allowed to fill the pit. The open pit created a local cone of depression in the water table both north and south of the pit, and groundwater and surface water was allowed to fill the pit. Once the pit had filled to a static level, this new local watershed discharged to the north. Surface recharge is predominantly from the east and west flanks of the pit, while groundwater recharge is from the unconsolidated aquifer south of the pit, which formerly had flowed to the south. Flow out of the HTDF drains to the north and enters the Middle Branch of the Escanaba River. A rock and earthen berm was constructed on the north end of the HTDF by CCI to regulate flow out of the flooded mine pit before it was used as a tailings disposal facility. Traverse Engineering Services (TES) (1984) indicated two culverts were constructed to regulate the flow out of the pit.

The findings of this hydrogeological investigation indicate a complex assemblage of glacial till, glacial outwash and at least one peat horizon overlying bedrock. Precambrian bedrock is exposed in several areas on the Project Site, including the ridge immediately north of the Mill, 150 ft south of the mill/office building, and west of iron ore tailings basin south. Depth to groundwater varies from less than 10 ft below ground surface (bgs) east of the mill buildings, to greater than 30 ft bgs near the HTDF. Groundwater flow across the area of the Mill is to the west and southwest, where it is captured by the wetland ponds in that area and eventually enters the Black River. However, groundwater at the western side of the area of the Mill is captured by the HTDF and flows into the HTDF. Water in the HTDF discharges through the subsurface and surface seeps at the northern face of the HTDF, an area that drains to the Middle Branch Escanaba River.

The relationship among the unconsolidated formations is complicated by the extensive back filling of low areas prior to and during construction of the former Humboldt Mine and Mill. The backfill consists of fine to coarse sand, gravel and rock from previously existing deposits on the property that were leveled and transported to fill low-lying areas, and waste rock taken out of the former Humboldt Mine. In many cases, it is difficult to distinguish sand, gravel and rock that have been used as fill from similar material that is found in place.

Undisturbed soils surrounding the vicinity are identified as the Rubicon sand. The soils are deep, well drained to excessively drained sands and gravels. The soils have very high to high hydraulic conductivity and low water holding capacity.

## **2.3 Hydrology**

### **2.3.1 Groundwater**

Groundwater in this area primarily occurs in the unconsolidated deposits overlying the bedrock. The bedrock formations in this area consist of igneous intrusive rocks and metamorphosed and recrystallized sedimentary rocks, and typically have very low incipient permeability. In general groundwater in consolidated formations in this area occurs along isolated fractures, joints and openings along bedding planes. Groundwater flow rates vary widely depending on the hydraulic conductivity of the hosting material and can occur under water table or artesian conditions. In the unconsolidated formations, although artesian conditions may occur locally, due to stratified glacial drift with low permeability horizons, the upper surface of the groundwater in this area is generally unconfined and is subject to atmospheric pressure. Groundwater is recharged from precipitation and drainage from higher elevations, which in this area are generally bedrock ridges that contain only a thin veneer of unconsolidated material, whereby runoff drains down to the glacial drift-filled valleys.

### **2.3.2 Surface Waters**

Western Marquette County is drained by a network of small to medium sized streams which generally flow to the southeast, eventually emptying into Lake Michigan. The primary streams in this area are the Middle Branch of the Escanaba River, the Black River and the Michigamme River. Large lakes are uncommon, but smaller lakes are abundant, connected by the stream network. The larger lakes in the area include Lake Michigamme, Lake Lory and the Greenwood Reservoir. Figure 1-3 displays the regional watershed and sub watersheds in the vicinity of the subject site.

Many isolated ponds and small lakes, without interconnecting streams occur in this area. Some occur on the bedrock ridges and are merely catch basins for precipitation that may completely evaporate during prolonged dry periods. Other ponds, generally in unconsolidated material at lower elevations are likely connected to the water table, but have no discernible surface flow.

### **3. Historical Environmental Investigations**

#### **3.1 Overview of Past Work**

Environmental investigations have been conducted at the Humboldt Mill site for more than fifteen years. Those investigations have evaluated conditions of the soil, groundwater and surface water since the close of gold ore milling by Callahan Mining Corporation in 1990 and are summarized here.

*Sundberg, Carlson and Associates, Inc. 1992. Ropes Mill Facility - Preliminary Hydrogeological Investigation.*

- ♦ SCA was retained by Callahan Mining Corporation to conduct and document a tank closure assessment at the Mill in 1990.

*Callahan Mining Corporation. 1995. Ropes Closure Document.*

- ♦ Callahan requests case closure of the Mill, based on documentation of the completion of physical reclamation activities, completion of required actions under an Administrative Consent Order, and achievement of water quality effluent standards for the HTDF without mechanical treatment.

*Callahan Mining Corporation. 1996. Characterization and Remedial Alternatives for Groundwater - Humboldt Mill Facilities.*

- ♦ Callahan Mining Corporation summarized the environmental investigations that had been completed to date. At that time, 16 monitoring wells had been installed near the Mill. Possible contaminant sources included an unknown upgradient source, floor drains, underground storage tanks, former stockpile areas and fill material. The report concluded that an unknown upgradient source is the most probable cause of continued metals contamination in groundwater at the site. The report was not specific as to the nature of this source.

*Sundberg, Carlson and Associates, Inc. 1996. Baseline Environmental Assessment - Volumes 1 - 3.*

- ♦ This report was prepared for Minerals Processing Corporation (MPC) and evaluated mitigation and cost alternatives. MPC purchased a portion of the Mill in 1995. MPC evaluated the environmental condition of the property by conducting a Phase I ESA, an environmental investigation and producing the three volume Baseline Environmental Assessment (BEA) report in order to limit MPC's liability for past environmental impacts. Several environmental investigations were conducted to produce the BEA, including soil, groundwater and surface water investigations on and around the area of the Mill. These investigations expanded on the previously conducted studies. The BEA identified a number of environmental concerns.

*Sundberg, Carlson and Associates, Inc. 1996. Phase I - Environmental Site Assessment - Former Ropes Milling Plant Property (Attachment A to BEA, included in Vol 1 of 3).*

- ♦ This report documented the findings of a Phase I ESA.

*Sundberg, Carlson and Associates, Inc. 1996. Baseline Environmental Assessment - Vol 2 of 3 - Investigative Report (Attachment B to BEA).*

- ♦ This report provided documentation of a soil and groundwater investigation, surface water analysis and PCB sampling in the mill.

*Sundberg, Carlson and Associates, Inc. 1996. Baseline Environmental Assessment - Vol 3 of 3 - Historical Environmental Documentation (Attachment C to BEA).*

- ♦ This report provides a collection of historical environmental documents including correspondence between Callahan and the Michigan Department of Environmental Quality (MDEQ), hazardous waste disposal manifests, the Pollution Incident Prevention Plan prepared by Callahan in 1984, and miscellaneous documents for the Humboldt Mill.

*Sundberg, Carlson and Associates, Inc. 1996. Leaking Underground Storage Tank - Closure Report.*

- ♦ SCA presented documentation supporting case closure of the leaking underground storage tank site at the mill, based on identifying groundwater on site as "groundwater not in an aquifer."

*Titan Environmental Corporation. 1997. Ropes Mill Site Closure - Phase II-DRAFT.*

- ♦ Titan Environmental Corporation identified seven tasks and the associated recommendations to achieve closure. These tasks included: development of closure standards, classification of groundwater, water table mapping, organic plume mapping, UST verification sampling, determining pyrite concentrate volumes and a pyrite landfill design assessment.

*Maxim Technologies, Inc. (Maxim). 1999. Qualifications of the Humboldt Mill Site, Michigan, for Closure Under Part 201.*

- ♦ This report documents the presence of three contaminant sources at the Mill and indicates that releases from the three sources may have commingled. The report states that Michigan regulations, as defined in Part 201 of Natural Resources and Environmental Protection Act (NREPA), permit an owner/operator to close a facility with multi-source contaminants under Part 201, if certain criteria are met. The report concludes that the criteria have been met and that Part 201 rules should govern site closure.

*Maxim. 2000. Remedial Action Plan for Closure of the Humboldt Mill Site Michigan Under Part 201*

- ♦ This report presents the final Remedial Action Plan intended to meet the part 201 requirements. The plan includes recommendations for monitoring groundwater quality and flow conditions, closure in place of the existing hydrocarbon plume, modeling to

predict degradation and attenuation rates, consolidation and capping of residual pyrite and implementation of institutional controls to eliminate potential exposure pathways.

Laboratory analytical results from these historical data sources have been compiled in separate tables by sample matrix and can be found in Appendix A. Laboratory analytical reports and other data sources are also included in Appendix A. Sections 3.2 through 3.4 will summarize the historical data for each medium.

### **3.1.1 Use of Historical Data**

Data, including complete or partial lab reports and data summary tables, were compiled from the sources discussed above. These data, were evaluated and divided into 3 tiers based on completeness and data confidence.

The three tiers were defined as follows:

- ♦ Tier 1 – Includes data with lab reports, accompanying chain-of-custody documents (COC), lab quality control samples and any summary tables of these data.
- ♦ Tier 2 – Includes data with partial lab reports without accompanying COC documents and lab quality control samples.
- ♦ Tier 3 – Includes report summary tables with no supporting lab documentation.

Summary tables of the historical soil, groundwater and surface water data are provided in Appendices A-1 through A-3. The supporting Tier 1, Tier 2 and Tier 3 data reports are provided in Appendices A-4 through A-6.

## **3.2 Summary of Soil Studies**

The earliest documented soil investigation is related to the UST closure assessment conducted in 1990 by Sundberg, Carlson and Associates (SCA, 1992). Later studies investigated a wider area, based on the earlier results, and were expanded to include investigation of the impact of industrial activity to support the preparation of a BEA (SCA, 1996) after MPC purchased the property in 1995. Historical soil sampling locations are shown in Figure 3-1. The analytical results were compared to R 299.5746, the generic residential soil clean-up criteria (Appendix A-1). The most conservative environmental protection criteria is the drinking water protection criteria (DWPC). Soil samples that exceed the DWPC can be found in Table 3-1. Maps showing these exceedances, are provided in Figures 3-2 through 3-14. Groundwater Surface Water Interface Protection Criteria (GSIPC) are evaluated in Section 5.

Available historical boring logs can be found in Appendix A-7. Sections 3.2.1 through 3.2.3 discuss the occurrence of volatile organic compounds (VOCs), inorganics and metals in soil that exceed the DWPC.

### **3.2.1 Volatile Organic Compounds**

VOCs were detected in concentrations that exceed the DWPC at one location in the vicinity of the vehicle maintenance area near the northwest corner of the mill/office building. This sample

(PL-4) was collected along the piping run on the north side of the building. No other VOC exceedances were detected.

### **Maintenance Shop Area**

Parameter	Units	Sample PL-4	Drinking Water Protection Criteria
1,2,4-Trimethylbenzene	ug/kg	56000	2100
Anthracene	ug/kg	100000	41000
Phenanthrene	ug/kg	110000	56000

### **3.2.2 Inorganics**

#### **Cyanide**

Cyanide was detected above the DWPC at two locations in the vicinity of the former pyrite stockpile area located south of the Mill. Samples were collected for laboratory analysis from three locations in this area: TP-34, TP-17 and a stockpile near TP-14. The sample from TP-17 stockpile exceeded the DWPC. The results are summarized below:

### **Former Stockpile Area**

Parameter	Units	Stockpile	Sample TP-17	Drinking Water Protection Criteria
Cyanide	ug/kg	10.5	6.6	4.0

The pyrite stockpile area was investigated by a series of test pits (TP-1 through TP-35) arranged in a grid pattern to assess the distribution and thickness of the remaining pyritic material stored to the south of the mill. This investigation, conducted in 1995 (SCA, 1996) identified a single, thin pyrite layer on the east end of the stockpile area, covered by a thin veneer of soil. Test pits on the western portion of the stockpile area identified multiple pyrite horizons that were likely formed by several grading events. The findings of this investigation estimated up to 4,000 cubic yards of non-pyritic fill material mixed with approximately 1,500 cubic yards of pyritic leach material. Two samples were collected for laboratory analysis. The results of the TCLP analysis indicated that the pyritic material was not likely to leach hazardous concentrations of metals, but the pH of the leachate was acidic. In addition, the concentration of nickel and manganese in groundwater in this area did exceed the residential drinking water standard. These metals are known to be present in the pyritic material.

### **3.2.3 Metals**

The limits of the buried pyrite trench area was investigated through physical description of a series of soil borings (T1 – T4 and T10 – T23) in 1995 (SCA 1996). The borings were authorized by MPC to estimate the volume of buried pyritic material. Antimony, arsenic, chromium, iron, manganese, nickel and silver were detected in concentrations that exceeded the DWPC in samples collected in the buried pyrite trench area during characterization of that area in 1998 (Maxim, 2000). The results are summarized below:

<b>Parameter</b>	<b>Units</b>	<b>Concentration Ranges</b>	<b>Drinking Water Protection Criteria</b>
Antimony <sup>1</sup>	mg/kg	4.3 – 30.7	4.3
Arsenic <sup>1</sup>	mg/kg	156 - 563	4.6
Chromium <sup>1</sup>	mg/kg	171 - 1220	30
Iron <sup>1</sup>	mg/kg	98800 - 203000	6
Manganese <sup>1</sup>	mg/kg	58.4 - 1030	1
Nickel <sup>1</sup>	mg/kg	330 - 780	100
Silver <sup>1</sup>	mg/kg	16.1 - 904	4.5

<sup>1</sup>See Table 3-1 for sample numbers

Magnesium was also detected in concentrations that exceeded the DWPC at several locations in the buried pyrite trench area during the 1998 soil sampling event. Lead is also noted because it exceeded the Direct Contact Criteria (DCC) which is lower than the DWPC. The results are summarized below:

<b>Parameter</b>	<b>Units</b>	<b>Sample Number</b>					<b>Drinking Water Protection Criteria</b>
		<b>SB-1"</b>	<b>SB-10"</b>	<b>SB-5"</b>	<b>SB-6"</b>	<b>SB-9</b>	
Lead	mg/kg	530	525	625	510	525	700*
Magnesium	mg/kg	22	104	12600	11500	13400	8,000

\*Direct Contact Criteria 400 mg/kg.

Arsenic, iron, manganese and nickel were also detected in concentrations that exceed the DWPC in a sample collected at the former scale area. There is very little documentation on the history or mitigation of metals in soil in this area. The results from the one sample collected at the former scale area are summarized below:

<b>Parameter</b>	<b>Units</b>	<b>Scale #1</b>	<b>Drinking Water Protection Criteria</b>
Arsenic	mg/kg	8	4.6
Iron	mg/kg	46000	6
Manganese	mg/kg	900	700
Nickel	mg/kg	140	100

The Toxicity Characteristic Leaching Procedure (TCLP) results from the soil sample at the former scale area contained detectable concentrations of arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, nickel, silver and zinc but did not exceed TCLP criteria. According to a report prepared by Maxim (2000) "most" of the pyritic soil in the vicinity of the former truck scales were excavated in 1998 and disposed in a local municipal landfill. There are no records documenting this event.



### **3.2.4 PCBs**

Evidence of PCBs from four wipe samples was detected in the mill building and Secondary Crusher (SCA, 1996). These wipe samples were collected near former transformer locations. Four additional soils samples were collected from soils beneath utility poles that contained transformers and are displayed on Figure 3-1 as samples PCB-1 through PCB-4. None of these soil samples contained detectable ( $\geq 300$  ug/kg) levels of PCBs.

## **3.3 Summary of Groundwater Studies**

Historical groundwater monitoring well sampling locations are shown in Figure 3-15. The analytical results were tabulated and compared to the R 299.5744 Residential Drinking Water Criteria (DWC) (Appendix A-2). Historical groundwater results that exceed the R 299.5744 DWC can be found in Table 3-2. Maps showing these exceedances by parameter are provided in Figures 3-16 through 3-32. Groundwater Surface Water Interface Protection Criteria (GSIPC) are evaluated in Section 5.

Appendices A-4, A-5 and A-6 provide the available laboratory analytical reports and other data sources. Available monitoring well construction forms and water well records can be found in Appendix A-7. The following sections discuss the occurrence of VOCs, inorganics, and metals in groundwater that exceed the DWC.

### **3.3.1 Volatile Organic Compounds and Semi-Volatile Organic Compounds**

Nine monitoring wells (MW-1 through MW-7, MW-9 and MW-10) were initially constructed in 1991 and 1992 to delineate the suspected VOC plume in the vicinity of the shop/office (SCA, 1992). In general, these wells identified very little impact of the petroleum release in groundwater, with the exception of the groundwater in MW-5. The data suggested that VOCs detected at MW-5 originated from the gasoline UST and extended to the southwest. Benzene, ethylbenzene and xylenes persisted at MW-5 at concentrations that exceeded the DWC. These same VOCs were not detected in groundwater samples collected from any other monitoring well during this period.

Eight additional wells were constructed between 1992 and 1996 in part to further delineate the known VOC plume to the south and west of the vehicle maintenance area in the shop/office building (MW-104 through MW-106). Laboratory analysis of groundwater samples collected from MW-104, in the vicinity of the known VOC plume, indicated benzene and xylene exceeded the DWC. The exceedances are summarized in Table 3-2 and on Figures 3-16 through 3-22. Over the period from 1995 through 1999 the semi-volatile organic compounds 2-methyl naphthalene, acenaphthylene, naphthalene and phenanthrene also exceeded the DWC.

### **3.3.2 Inorganics**

Ammonia and sulfate were only detected at concentrations exceeding the DWC in the October 1999 sampling event. These conditions occurred at wells located within or near the former pyrite stockpile and are summarized below and on Figures 3-23 and 3-24.

Parameter	Units	MW-11	MW-102	MW-103	MW-107	MW-4	MW-7	Drinking Water Criteria
Ammonia	mg/L	12.6	3.7	1.4	3.5	2.8	2.5	10
Sulfate	mg/L	25	6940	260	660	1550	1070	250

### 3.3.3 Metals

The groundwater investigation assessing the impact of dissolved metals that may have originated from pyrite-bearing stockpiles and other mining related activities on the property began in 1992 with monitoring wells MW-11 and MW-12. Concentrations of arsenic, iron, lead and manganese in groundwater generally exceeded the DWC through 1999. Metals analysis of groundwater was expanded in 1995. Monitoring wells MW-101 through MW-103 were constructed to further assess the presence of metals in groundwater related to the storage of pyritic leach residue stockpiled south of the mill. Concentrations of arsenic, cadmium, iron, lead, manganese and nickel exceeded the DWC in the sampling event conducted in the fall of 1995 and in the subsequent sampling event in June 1996. Dissolved metals in groundwater were next analyzed in October, 1999 when chromium and sodium were added to the parameter list. Chromium exceeded the DWC at MW-102. Sodium exceeded the DWC at MW-11. These data are spatially presented on Figures 3-25 through 3-32.

### 3.4 Surface Water Studies

Historic surface water investigations at the Mill were limited and focused specifically on isolated surface depressions near the pyrite stockpiles that temporarily held precipitation or snow melt prior to evaporating or running offsite. Five surface water samples were collected in November, 1995 and compared to Rule 57 Surface Water Criteria (Appendix A-3). Historical surface water monitoring locations are shown in Figures 3-33 through 3-36. One surface water site that was inspected, but not sampled (SW-3), is also shown. All historical surface water results that exceed Rule 57 criteria can be found in Table 3-3. Maps showing these exceedances by parameter are provided in Figures 3-33 through 3-36. Appendix A-4 provides the available laboratory analytical reports and other data sources.

## 4. Methods of Investigation

The Phase I ESA (Foth, 2007) identified RECs in the vicinity of the Mill facilities. Section 3 of this report evaluated historical data related to some of the identified RECs and provides documentation related to potential contaminant levels at the Project Site. This section describes the methods of investigation to assess the current state of RECs and their potential impact on soils, groundwater and surface water. In addition this investigation was designed to collect information to support an Environmental Impact Assessment per the requirements of Part 632 of NREPA.

Another goal of this Phase II field investigation was to collect the information necessary to complete a Category S BEA at the Project Site in accordance with MDEQ Part 201 regulations [*"Category S BEA- " means a BEA that is conducted for a property where the hazardous substances to be considered are the same as the hazardous substances that are known or reasonably believed to have previously been released at the property or are present as a result of the decomposition of hazardous substances that were released, except as provided in R 299.5903(9)"].*

Note that this Phase II investigation focuses on the mill site and nearby areas for which KEMC is seeking liability protection. This Phase II investigation does not focus on the HTDF.

### 4.1 Phase II Soil Investigations

A soil investigation was completed in the Fall of 2006 in order to determine the environmental impact of RECs identified in a recent Phase I ESA (Foth, 2007). The goal of the investigation was to collect data to characterize the environmental condition of the soil in the vicinity of the Project Site and to supplement historical data collected during previous environmental studies.

#### 4.1.1 Methodology

In the Fall of 2006, soil borings were completed across the Project Site. The soil boring locations are shown on Figure 4-1. The soil borings, were located to define subsurface conditions at specific locations and characterize the subsurface conditions in areas of concern as defined by the RECs documented in the Phase I ESA.

##### 4.1.1.1 Drilling Methods

Forty-two soil borings were drilled using hollow stem auger (HSA) methods, eighteen soil borings were drilled using sonic drilling methods. Soil boring details are summarized in Table 4-1. The sample depths and sampling program for each boring is listed in Table 4-2. Complete boring logs, boring abandonment forms, and well construction reports can be found in Appendix B. The procedures and requirements for soil borings were as follows:

- ♦ A minimum of one soil boring per acre and/or a soil boring spacing of about 200 ft.
- ♦ In the vicinity of the iron ore tailings basins immediately east of the mill. This was completed over the approximate western half of the basin.
- ♦ Soil borings were completed using HSA techniques (ASTM 5784), and sonic boring methods were used when HSA proved to be ineffective or impractical.

- ◆ Continuous split spoon samples (ASTM D1586) were collected from the ground surface to a depth of 25 ft below grade, in the vicinity of the Mill, where refusal did not occur. Continuous sampling was required to define the thickness and classification of topsoil, any fill materials, peat, glacial till or other soils encountered.
- ◆ Except for borings at SB-637 and SB-644 which were sampled continuously, split spoon samples were taken at 5 foot intervals in the iron ore tailings basins and at depths greater than 30 ft in all soil borings.
- ◆ The entire recovery of each split spoon sample was retained for review after the field work was completed and intervals were selected for soil laboratory testing. Geotechnical testing work was completed by Miller Engineer's and Scientists (Sheboygan, WI) and analytical lab work was completed by Pace Analytical Laboratories (Green Bay, WI).
- ◆ A description of each soil sample recovered in the boring log was completed in accordance with ASTM D2488 and ASTM D5434.
- ◆ Attempts were made to recover relatively undisturbed samples of cohesive soil and peat using three inch Shelby Tubes (ASTM D1587). However, no cohesive soil was encountered and intervals of peat that were encountered were not recovered due to the compaction of that material by the overlying fill material.
- ◆ All soil borings not completed as groundwater monitoring wells were abandoned in accordance with MDEQ Well Construction Code Standards by the drilling contractor immediately after drilling. Monitoring well construction logs are provided in Appendix B-1. Soil boring abandonment forms documenting the abandonment techniques and materials used are provided in Appendix B-2.
- ◆ A geologist, hydrogeologist or qualified soil technician from Foth prepared soil boring logs, documented well construction and obtained and containerized retained soil samples.

#### **4.1.1.2 Deviations from Drilling Program**

Deviations from the planned drilling included minor changes to the proposed boring and well locations, based on overhead or subsurface conditions.

- ◆ A proposed soil boring that was to be converted into a monitoring well in the paved area on the south side of the mill office (to replace historical monitoring well MW-4), and a soil boring south of the maintenance area were not drilled to comply with the KEMC safety requirement to not operate a drill within 100 ft of an overhead power line. The monitoring well was moved to KMW-2 and the boring was moved to KSB-7. That limitation also eliminated a proposed well between the buried pyrite and KMW-9.
- ◆ Proposed soil boring KSB-16 was not drilled due to extremely difficult drilling conditions in the vicinity of the buried pyrite. Much of that area was a former waste rock pile for the early Humboldt Mining operations. In later years this area was used as an access roadway for mining and milling vehicles. The subsurface can be characterized as compacted boulders of very hard, lean iron formation and quartzite with a sand to silty

sand matrix. KMW-5 and KMW-6 were drilled in this area. Each monitoring well took more than ten hours to drill an average depth of 50 ft. The subsurface conditions were very hard on the drilling equipment; parts were broken and some drilling rods were lost and then retrieved in the hole for KMW-6A.

- ♦ KSB-18 was added to further characterize the subsurface beneath the buried pyrite stockpile area and to determine if peat was present at depth. KSB-19 was added to evaluate the subsurface beneath the former fuel oil AST used to operate the former pellet plant.
- ♦ SB-622 and SB-619 each encountered auger refusal at a shallow depth using the HSA drill. The borings were redrilled with the mini-sonic drill in order to assess the subsurface to a greater depth. SB-45, -46, and -47 all encountered auger refusal at shallow depths, due to their location on the rock berm enclosing the iron ore tailings storage facility. They were not redrilled due to their distance from the mill.
- ♦ One hand auger sediment sample (HA-1) was collected in the pond on the east side of the former fuel oil AST.
- ♦ Two hand auger soil samples were collected in the vicinity of the stormwater discharge point and the septic drainfield. Heavy tree cover and steep terrain precluded the use of either HSA or the mini sonic. Soil sample HA-2 was collected approximately ten ft south of the stormwater outfall, at a depth of one to two ft below grade. Soil sample HA-3 was collected approximately 150 ft southwest (downgradient) of the drainfield. Rocky subsurface conditions prevented a soil sample from being collected within the drainfield.

#### **4.1.1.3 Handling of Field Investigation Wastes and Equipment Decontamination**

Field investigation wastes generated during this investigation included native soils, fill consisting of sulfide and oxide ore, iron oxide tailings, mining waste and groundwater from monitoring well development. The drilling contractor was responsible for containerizing and disposing of all wastes generated during the field investigations as described below.

- ♦ Select drill cuttings from soil borings near the mill were temporarily stored in drums on-site pending review of analytical results. Native soils and fill that were not obviously contaminated were thin spread at the drill site.
- ♦ Groundwater generated during the development of wells and piezometers was containerized by the drilling contractor pending review of analytical results.

## **4.2 Groundwater Investigation**

A groundwater investigation was initiated in 2006 to determine the environmental impact on groundwater of RECs identified in a recent Phase I ESA at the Project Site (Foth, 2007). The goal of the investigation was to collect data to characterize the environmental condition of the groundwater in the vicinity of the mill site and outlying areas and to supplement historical data collected during previous environmental investigations. Additional groundwater monitoring wells and piezometers were needed to accomplish this task. The locations of all the monitoring wells and piezometers on the subject site are provided on Figure 4-1.

#### **4.2.1 Methodology**

In the Fall of 2006, 17 monitoring wells and 3 piezometers were completed in the area of the Mill. The groundwater monitoring wells and piezometers were located to define subsurface conditions at specific locations and characterize the subsurface conditions in areas of special concern as defined by the RECs documented in the Phase I ESA (Foth, 2007).

##### **4.2.1.1 Drilling Methods**

Two monitoring wells, and one piezometer and were drilled using HSA methods, while fifteen monitoring wells, and two piezometers were drilled using sonic drilling methods. A detailed summary of the drilling program and well construction is provided as Table 4-1. The groundwater sampling program is listed in Table 4-3. The procedures and requirements for monitoring well installation were as follows:

- ♦ Monitoring wells were completed using HSA techniques (ASTM 5784), and sonic drilling methods were used when HSA proved to be ineffective or impractical.
- ♦ Geotechnical lab work was completed by Miller Engineer's and Scientists (Sheboygan, WI) and analytical lab work was completed by Pace Analytical Laboratories (Green Bay, WI). Geotechnical laboratory reports are provided in Appendix B-3.

##### **4.2.1.2 Deviations from Drilling Program**

Deviations from the plan included minor changes to the proposed boring and well locations, based on overhead or subsurface conditions.

- ♦ The boring planned for the former scale area was not constructed, due to extremely difficult drilling conditions encountered in the construction of nearby wells KMW-5 and KMW-6, and lack of specific information regarding the location of the scale area excavation.
- ♦ Initial construction of KMW-6 resulted in a dry well. KMW-6A was redrilled five ft south of KMW-6.
- ♦ A proposed soil boring that was to be converted into a monitoring well in the paved area on the south side of the Mill office (to replace historic well MW-4) was not drilled in order to comply with the KEMC safety requirement to not operate a drill within 100 ft of an overhead power line. The monitoring well was moved to KMW-2. That limitation also eliminated a proposed monitoring well between the buried pyrite and KMW-9.
- ♦ KMW-4 was designed to be a water table monitoring well and piezometer well nest. However, bedrock was encountered at a shallow depth, which would not have provided sufficient separation of the two screens. As such a piezometer was not constructed at this location.
- ♦ MW-605 and P-605 were moved to the north following the marking of the natural gas line on the first day of drilling.

Monitoring wells were installed based on the following criteria:

- ♦ Four groundwater monitoring wells, three paired with a piezometer to form a well nest, were constructed in the western half of the iron ore tailings basin east of the Mill.
- ♦ Groundwater monitoring wells were not installed in drill holes advanced to a depth greater than the desired well depth. A separate boring was blind drilled at locations where the desired well depth was shallower than the boring depth required.
- ♦ Groundwater monitoring wells were constructed approximately eight ft into the water table.
- ♦ Samples for water used for drilling the wells or piezometers was obtained and analyzed. Samples were taken from the driller's water tank. The results of this sampling are summarized in Table 4-4.
- ♦ If possible, piezometers were constructed approximately 10 ft away from the water table monitoring well and approximately 25 ft below the bottom of the adjacent water table monitoring well.
- ♦ Wells were constructed with threaded schedule 40 polyvinyl chloride (PVC) pipe with "O" ring seals if the well depth was less than 50 ft.
- ♦ Wells were constructed with threaded schedule 80 PVC pipe with "O" ring seals for well depths greater than 50 ft.
- ♦ Groundwater monitoring wells intersecting the water table were constructed with 10 foot factory slotted, 10 slot screens.
- ♦ Piezometers were constructed with 5 foot factory slotted, 10 slot screens.
- ♦ Lockable, steel protective pipes with keyed alike locks were installed over each well and piezometer. Older wells with no locks or damaged surface protection were retrofitted.
- ♦ Wells were developed approximately one week to 10 days after construction. Well development was completed by the drilling contractor and the data was recorded. Well development logs are provided in Appendix B-2.
- ♦ Slug tests were completed on individual monitoring wells by North Jackson Company (NJC). The data were analyzed via methodology described by Bouwer and Rice (1989) and are summarized in Appendix B-4.
- ♦ All drilling locations were surveyed upon completion. Survey data was collected in United States (U. S.) State Plane 1983, Michigan North, 2111 coordinate system.

#### **4.2.1.3 Groundwater Monitoring Well Development and Sampling**

Groundwater monitoring of historic wells were conducted by NJC in June and July 2006 at the site by sampling monitoring wells constructed prior to 2000. All of the existing wells were

developed prior to sampling in June 2006. The Phase II ESA monitoring wells and piezometers were constructed in September and October 2006 as part of the comprehensive subsurface investigation at the Project Site in response to the findings of a Phase I ESA (Foth, 2007). All of the wells and piezometers constructed in 2006, along with the historic wells were sampled in a single event in November 2006 to assess the water quality and the characteristics of the aquifer in the vicinity of the Project Site. In addition to identifying the presence or absence of environmental impact from the RECs, the monitoring plan was designed to meet both mine permitting and BEA requirements.

In addition to groundwater monitoring at monitoring well and piezometer locations, water elevations were read at seven staff gauges placed in areas that appear to have standing water for most of the year (HMS -001 through -007) in order to evaluate the relationship between the groundwater and local surface water expressions. Sample locations are shown on Figure 4-1.

Groundwater monitoring was completed at each well location in November 2006. Staff gauges were also read during this event. Prior to sampling, each well was measured for depth to static water level and purged using low-flow sampling methods in accordance with MDEQ low-flow sampling methods described in MDEQ Remediation and Redevelopment Division (RRD) Operational Memo No. 2 Attachment 5 (Appendix C). Pre-sampling purging was considered complete when at least three casing volumes were evacuated from the well and three consecutive field measurements (collected at least one-half a casing volume apart) did not change by more than the following:

- ♦ Conductivity                      +/- 10%
- ♦ pH                                      +/- 10%
- ♦ Temperature                      +/- 10%

In order to minimize sampling time and decontamination procedures, dedicated purge pumps were installed in each well. Purge water from the wells was containerized for proper disposal pending review of the analytical results. Field sampling at each site included field measurement of depth to water (prior to purging), temperature, dissolved oxygen, specific conductance, redox, turbidity, and pH. The volume of purged water was recorded.

Field parameters and samples for laboratory analysis were collected by NJC. Samples were placed into clean containers of appropriate size and type specified for the analysis. Water samples from each well and piezometer were collected and analyzed for all parameters listed in Tables 4-5 and 4-6. Analysis of the parameters in Table 4-7 only applied to wells: MW-601, MW-101, MW-102, MW-11, MW-103, KMW-2, MW-9, MW-6, MW-5, PW-4, MW-104, KMW-1, PW-1, KMW-4, and KMW-6. All samples were sent to Pace Analytical Laboratory (Green Bay, WI).

KEMC's existing Quality Assurance/Quality Control (QA/QC) program (North Jackson Company, 2004) was maintained during all sample collection and analysis procedures. All non-dedicated sampling equipment (including sampling pumps) was decontaminated between wells and before each sample. Contaminated wash water and purge water was containerized for proper disposal.



Calibration of all field equipment was completed per the existing QA/QC program (North Jackson Company, 2004). Field calibration requirements were in compliance with the technical procedure describing the instruments' use and/or with the manufacturer's instructions issued with the equipment.

To assess the precision of field measurements, duplicate field measurements were obtained at a frequency of 1 in 10 measurements or 1 set per day, whichever was greater. Duplicate field measurements were made using a fresh portion of sample relative to the original measurement and after rinsing the meter using the same procedures used between wells.

To assess the precision of field sampling procedures and variability of the sample source, field replicates were collected at a frequency of 1 in 10 samples. Each field replicate was collected after performing the decontamination and purging routines used for normal sample collection. One set of atmosphere blanks was collected each day for VOC, polynuclear aromatic hydrocarbon (PHA) and metals analysis.

### **4.3 Surface Water Investigations**

A topographic and field review of the Mill was conducted and information from that review indicated that several surface water monitoring locations were necessary to adequately represent potentially impacted surface water resources in the vicinity of the Mill. Although data collection recommendations were designed to meet both permitting and Phase II ESA requirements, the data can also be used to characterize surface water quality on the subject site and areas immediately off-site.

Regional locations selected for sampling include the stream reaches and lakes/ponds illustrated on Figure 4-2. The lake/pond sites include two sites on Lake Lory (LKL-001 and LKL-002), one on the water-filled HTDF (HMP-001), two iron ore tailings ponds east of the Mill (HTP-001 and HTP-002), one wetland/pond south of the Mill (WLD-001) and two small ponds east of the HTDF and northeast of the Mill (WLD-003 and WLD-004).

Stream sampling sites include reaches of the Middle Branch of the Escanaba River (MER-001 through MER-003), outflow of the flooded HTDF (HMP-002), outflow from the wetland south of the Mill (WLD-001 NW and WLD-001 SE), outflow from Lake Lory (EBR-001), an iron ore tailings pond southwest of the Mill (WBR-002), a tributary of the Black River referred to in this report as the West Branch of the Black River (WBR-003), outflow from Mud Lake west of an iron ore tailings pond (WBR-001) and the main branch of the Black River system (MBR-001) south of the Mill. The sample sites were located in the field using hand-held Global Positioning System (GPS) equipment. At each stream site an appropriate reach of the stream was identified and marked for future reference.

#### **4.3.1 Field Procedures**

Surface water samples were collected quarterly at the sample sites by NJC beginning in August 2006. Field parameters and flow measurements have been collected on a monthly schedule. Samples were sent to Pace Analytical Laboratory (Green Bay, WI) and analyzed for the parameters listed in Table 4-8. In addition to the surface water sampling, sediment samples were collected from the sample sites during the first sampling event and analyzed for the parameters

listed in Table 4-9. In the streams the sediment sample was collected from the slowest portion of the stream.

At each stream sampling site, a cross stream transect was constructed following standard field procedures. Water depth along the transect was measured to establish the cross-sectional area and streambed morphology. Stream velocity measurements using a flow meter were collected along each transect, following standard field procedures. The stream velocity information along with the stream cross sectional area was used to calculate stream discharge at each site

At lake/pond sites the field measurements were collected with depth to provide a depth profile for each of the field parameters. Measurements were collected at one meter (3 ft) intervals to the bottom of the lake/pond.

Sampling conformed to the existing KEMC Quality Assurance Project Plan (QAPP) (North Jackson Company, 2004). The sampling team donned new, clean powderless latex gloves at each site, prior to sampling. For stream sample sites the technician stood downstream of the sample site and slowly submerged the laboratory supplied container into the main flow of the stream (thalweg) at a shallow angle, allowing the container to fill while minimizing agitation and aeration of the sample. The filled containers were capped, labeled, noted on the chain-of-custody, and placed in a cooler on ice. The lake/pond sample sites were sampled from a boat using a Niskin sampling bottle or equivalent. At each lake/pond sample site, two samples were collected. One sample was collected from a depth approximately midway between the thermocline/chemocline and the water surface, identified with a suffix E. The second sample was collected between the thermocline/chemocline and the bottom, identified with a suffix H. The thermocline/chemocline was determined from the profile of field parameters. If the thermocline/chemocline was not detected, the lake/pond sample was collected at 20 percent of the total water column.

The field quality assurance protocols included the collection of a “blind” replicate sample and a field blank with each quarterly sampling event. All samples collected for laboratory analysis were handled under strict chain-of-custody procedures. In addition, laboratory quality control procedures included analysis of a matrix spike and matrix spike duplicate to assess analyte recovery, laboratory control samples and laboratory fortified blank for ongoing precision assessment, and instrument blank and method preparation blank to assess laboratory analytical instrument baseline drift.

#### **4.4 Investigation of Mill Buildings and Stockpiles**

The mill buildings were investigated to assess the characteristics of stockpiled materials, the potential occurrence of PCBs and other potential environmental hazards.

##### **4.4.1 Stockpile Sampling**

The intent of the stockpile sampling program was to obtain information about characteristics of stockpiled materials remaining from past operations at the site. Sample areas included stockpiles in the mill building and stockpiles located in the old crusher buildings west of the office and mill building. In addition, samples were collected from two aboveground storage pile areas located outdoors. Sampling included 20 discrete sample areas. The mill buildings samples were

analyzed for the parameters listed in Table 4-10. A site map showing sample locations is provided on Figure 4-3.

#### 4.4.1.1 Methodology

Prior to collecting the stockpile samples, a reconnaissance of the buildings was performed to identify stockpiles for sampling. Stockpiles were identified and marked on a site map. A description of the stockpile samples is provided in Table 4-11. Horizontal and vertical dimensions of each stockpile were measured using a tape measure. Stockpile dimensions were recorded in a field book. The dimensions were used to calculate the approximate volume of each stockpile. Volume calculations were then recorded in the field book.

Stockpiles were sampled by collecting composite samples at each sample location. Smaller stockpiles required collection of only one composite sample. However, larger stockpiles sometimes required more than one composite. The number of composite samples required was based on the approximate volume of material in each stockpile following the guidelines in the table below.

#### Stockpile Sample Requirements

Volume of Soil in Stockpile (cubic yards)	Minimum Number of Composite Samples
< 200	1
200 – 500	2
500 – 1000	3
1000 – 2000	4
Each additional 2000 cubic yards	1

Once the volume of the stockpile was estimated, the area was divided into sections of approximately equal volume, with one section for each composite sample. Samples were collected by the field crew using a pre-cleaned hand auger or other appropriate tool. The field crew obtained four to six hand auger borings for each composite sample and collected one to three sub-samples from each boring. A variety of depths and locations of the stockpile were sampled. Sub-samples were collected from a depth of greater than one foot below the pile surface and were of approximate equal volume. Samples were analyzed for total and TCLP metals. Cyanide was also identified as an analyte in that it may have been present in certain materials processed in the gold circuit.

Each composite sample was created using the following procedure:

- ♦ Combine all sub-samples in a large clean stainless steel mixing bowl;
- ♦ Decant or drain away any liquids;
- ♦ Remove large stones, sticks and vegetation;
- ♦ Thoroughly mix the sub-samples together with a clean stainless steel or disposable spoon;
- ♦ Transfer an adequate volume of the composite sample to the sample container provided by the laboratory;
- ♦ Wipe the threads, then cover, label and seal the container.

For quality control purposes, duplicate samples were collected and submitted with the set of samples. One duplicate for every ten or less samples was submitted to the laboratory. Samples to be split for duplicate analyses were first homogenized in a pre-cleaned stainless steel bowl. The duplicate sample was submitted to the laboratory as a “blind” sample.

Re-usable sampling equipment that came into contact with the sample, including stainless steel bowls, hand augers, etc. was decontaminated between each sample. All sub-samples collected for a single composite sample were considered to be one sample, unless the sub-samples were used for both discrete and composite samples. Sampling equipment was cleaned using the following procedure:

- ◆ Using a non-phosphate soap and clean potable water solution, wash the equipment to remove all visible soil particles, changing the wash water at regular intervals;
- ◆ Rinse with potable water to remove all soap;
- ◆ Rinse with acetone or methanol. Wiping the equipment with an acetone or methanol saturated towel is acceptable, but the towel must be disposed of after each use;
- ◆ Triple rinse the equipment with deionized water. If deionized water is not available, then distilled water may be used;
- ◆ If time allows, air dry and store on a clean surface until used.

Sampling team members wore a new pair of disposable gloves during each sample collection. Gloves were disposed between each composite sample.

A record was kept of the distance from each sample location (including individual sub-sample locations within each composite sampling area) to two permanent immobile objects such that sampling areas could easily be relocated. A sketch was also made of the area, with sampled areas clearly identified. In addition, photographs were obtained, annotated with the date, photographer, sample number and orientation of the sample area.

Sample containers used were provided by the laboratory and were dependent on the sample matrix and analyses desired. All sample containers were filled completely, so that minimal air space remained in the sample containers, unless a specific collection method required a pre-measured quantity and/or field preservation. Once opened, the containers were used immediately. If the container was used for any reason in the field, (e.g., screening) and not sent to the laboratory for analysis, it was discarded.

Immediately after collection, the sample label was affixed to all sample containers. Labels included the following information:

- ◆ Project title and location;
- ◆ Sample location;
- ◆ Sample identification number;
- ◆ Date and time of sample collection;
- ◆ Type of sample (grab or composite);

- ♦ Initials of sampler;
- ♦ Preservative used;
- ♦ Sample analysis requested.

This information was written in indelible ink. Samples were placed on ice in a laboratory supplied cooler to maintain sample temperature at 4 °C.

COC procedures allowed for tracking of possession and handling of individual samples from the time of field collection through laboratory analysis. Sample COC documentation was prepared by completing a COC form. The COC was prepared by the sampler(s) at the time of sampling.

After sample collection, the samples were securely stored and packaged as required by analytical protocol until they were delivered to Pace Analytical Laboratory in Green Bay, WI. COC records were placed in a plastic bag and transported with the samples.

Additional samples of the buried pyrite were collected via hand augers. These samples are labeled on Figure 4-3 as HA-1BP, HA-2BP and HA-3BP. These samples were analyzed for total metals and TCLP and synthetic precipitation leaching procedure (SPLP) metals.

#### **4.4.2 PCB Sampling**

During the Phase I ESA evaluation, oil staining was noted on the floor adjacent to one of two motor control centers inside the building. Although historical reports for the site indicate that all PCB transformers were removed from the buildings, there is no discussion regarding the possibility of PCB equipment still remaining inside electrical control cabinets.

In addition to oil staining on the floor, it was also noted during the Phase I ESA that a brown oily material had leaked down the side of the concrete block office structure located inside the mill building. Some of the material had coagulated into discrete layers of material. Both of these areas were sampled. The location of these samples are shown on Figure 4-3.

##### **4.4.2.1 Methodology**

To assess oil staining on the floor, a standard PCB wipe test was performed in two areas within the stain area and adjacent the electrical equipment in accordance with the definition in 40 Code of Federal Regulations (CFR) 761.123. Samples were obtained by using a standard-size template (10 centimeters by 10 centimeters, or 100 square centimeters (cm<sup>2</sup>) to delineate the area to be sampled. The wiping medium was a gauze pad that was saturated with hexane. The gauze pad was prepared in the laboratory and the wiping medium was stored in sealed glass vials until it was used for the test. The actual wipe test was performed very quickly after the hexane was exposed to the air. The sample was obtained by wiping the grid with parallel strokes across each axis until complete coverage was obtained (the entire surface was wiped twice). The gauze pad was then returned to the glass vial container. A set of disposable gloves was used by the sampler during collection of each sample. These samples are referred to as M-2 East and M-2 West on Figure 4-3.

To assess the brown oily material, several equal portions of the material were sampled in several places using a clean spatula to produce a composite sample (M-6). Sample material was placed into a clean glass container and closed immediately after sample collection.

Subsequent to sampling, all containers were placed into a cooler and kept at 4 degrees Celsius (°C). COC forms were used to identify the samples as they were being shipped to the laboratory for analysis. All samples were analyzed for seven Aroclors as well as for total PCBs.

#### **4.4.3 Other Materials Sampling**

In addition to sampling “stockpile” materials that were described in Section 4.4.1, other materials inside the buildings were noted during the Phase I ESA that were believed to warrant further evaluation. These were primarily former process materials that either had been released from storage tanks inside the building or were being stored in large quantities in open containers. These included the following materials and locations:

- ♦ Sludge that had collected in a large sump area in the basement of the mill building near the area where filter presses are located on the first floor. This sample location is identified on Figure 4-3 as M-1).
- ♦ Material that had leaked out from the bottom of an old thickener located in the southeast corner of the mill building. It is possible that process materials may be from former gold processing in the building. This sample location is identified on Figure 4-3 as M-4.
- ♦ A tank of dried material is located in the eastern end of the mill building. While the tank is currently not leaking, a certain quantity of white powder had been noted at the end of a pipe at the bottom of the tank. This sample location is identified on Figure 4-3 as M-5.
- ♦ A large open tank is located inside the mill building at the eastern end. This tank is about three-quarters full of water, but was also noted during the Phase I ESA to possibly contain a layer of oil. This sample location is identified on Figure 4-3 as M-3.

##### **4.4.3.1 Methodology**

To assess whether contaminants in these materials exceed MDEQ cleanup levels, solid materials identified in the first three bullets above (M-1, M-4 and M-5) were analyzed for total and TCLP metals. In addition, the second and third samples (M-4 and M-5) were also analyzed for total cyanide, in that it is believed these materials may have been associated with gold processing at the site. Due to the visual presence of an oil sheen, the sample identified as M-3 was analyzed for VOCs. All samples were grab samples using sample collection jars provided by the analytical laboratory. A clean spatula was used to collect solid samples of material. The liquid sample was obtained by dipping the container across the surface of the tank of water.

Subsequent to sampling, samples were labeled and placed into a cooler at 4 °C. All sampling took place on October 31, 2006.

#### **4.5 Asbestos and Lead**

As a result of visual observations made during the Phase I ESA, KEMC authorized Foth to retain Legend Technical Services, Inc. (Appleton, WI) to conduct an asbestos and lead evaluation inside buildings at the site. Both evaluations were conducted on August 15 and 16, 2006.

#### **4.5.1 Methodology**

Asbestos was evaluated in all buildings by conducting the inspection using an Accredited State of Michigan Asbestos Inspector. All suspect materials within the buildings that were accessible were sampled. Roofing materials were not sampled during the evaluation. A total of 83 samples of suspect asbestos-containing building materials were sampled. Analysis was performed on all samples using polarized light microscopy.

Lead paint samples were collected in a non-destructive manner using a X-Ray Fluorescence (XRF) Lead Paint Analyzer. This unit uses a radiation source of Cobalt-57 with a maximum radiation activity of 12 millicurie for paint identification.

## **5. Results of Phase II**

Eighty soil borings were completed in the vicinity of the mill buildings and the area up to 1,200 ft to the east, south and west of the facility. Eighteen of the soil borings were converted into monitoring wells or piezometers. Soil, groundwater, surface water and other media have been sampled for laboratory analysis and geotechnical testing in and around the Humboldt Mill in the performance of this Phase II ESA. The results are presented in the following sections.

### **5.1 Geology and Hydrogeology**

The findings of this subsurface investigation indicate a complex assemblage of glacial till, glacial outwash and at least one peat horizon overlying bedrock. Precambrian bedrock is exposed in several areas on the Project Site, along the ridge immediately north of the Mill, 150 ft south of the Mill/Office building, and west of iron ore tailings basin south. Depth to groundwater varies from less than 10 ft below ground surface (bgs) east of the mill buildings, to greater than 30 ft bgs near the HTDF. Groundwater flow across the main portion of the Project Site is to the west and southwest, where it is captured by the wetland ponds in that area and eventually enters the Black River.

#### **5.1.1 Geology**

The existing surficial geology is predominantly sand, gravel and rock fill, and iron ore tailings, with lesser amounts of native sand and gravel and bedrock (Figure 5-1). However, without exception, all of the soil borings intersected disturbed soils on the surface. The geology of the unconsolidated material consists of a complex assemblage of glacial till and outwash; fill consisting of fine to coarse sand, gravel, cobbles and boulders, peat and iron ore tailings. The depth to bedrock in the area ranges from greater than 50 ft below grade, to zero ft, where it is exposed at the surface.

The subsurface geology is shown in cross sections in Figures 5-2 through 5-15. Structural fill was placed over much of the area south of the mill buildings in previously low-lying wetland areas. This material consists of coarse sand and gravel, cobbles and boulders extracted from borrow pits in the vicinity of MW-605, a previously existing hill between MW-605 and the gas main pressure relief station, and broken rock (low-grade iron ore) taken from the former Humboldt Mine during construction. Standard penetration testing (SPT) in this area returned high blow counts ranging from 20 to 50+, indicating very dense subsurface conditions, due to the abundance and significant thickness of cobble and boulder fill. Conventional HSA drilling was conducted with extreme difficulty in this area. In fact, in the area immediately west of Iron Ore Tailings Basin North and South, eleven borings could not be completed with HSA due to the rocky subsurface conditions. These borings were completed with a sonic drill, without SPT. However, detailed borehole logging confirmed the presence of more than ten ft of coarse fill material in most of these borings. The remaining borings intersected coarse gravel with cobbles and sand that may be fill or may be native material.

Twenty seven soil borings intersected the eastern tailings basins and identified a wedge of iron ore tailings more than 50 ft thick overlying in situ peat, sand and gravel outwash and till. The tailings are contained primarily by a constructed berm stretching between previously existing hills of sand, gravel and bedrock and occur as a wedge, or delta, with a thickness ranging from at least 50 ft in the northern area, to approximately 20 ft thick in the southernmost area tested. The



tailings may be thicker or thinner to the north or south, respectively, away from the drilling conducted in the tailings basin.

The iron ore tailings were deposited directly on glaciofluvial sand and gravel, and in some areas, peat. Prior to construction of the facility in 1954, this area was a wooded wetland divided by isolated upland areas and low bedrock exposures (Figure 5-16). In order to construct the mill, this area was filled with the unconsolidated material from the intervening uplands and development rock taken out of the former Humboldt Mine. Soil samples collected during the recent investigation contained wood fragments on top of the peat horizon with multiple growth rings. SPT of the tailings generally returned very low blow counts indicating a relative density ranging from very loose to medium dense. The relative density increased at depths. However, it was observed that hydrostatic pressure forced the saturated tailings into the hollow stem, influencing the SPT results.

#### **5.1.1.1 Geotechnical Results**

Twenty-eight geotechnical samples were collected and analyzed from twenty-four soil boring locations in September 2006. Results from the geotechnical testing are summarized in the boring logs in Appendix B-1 and the lab reports are included in Appendix B-3. The reports provide information on grain size analyses for select soil borings. Soil samples were analyzed for selected geotechnical testing to more accurately describe the soil types within the existing tailings basin, to ensure accuracy of the field logs, and for collection of engineering data.

Based on the results of the geotechnical testing, the tailings within the tailings pond are predominantly brown sandy silt and silty sand.

#### **5.1.2 Groundwater Flow**

Groundwater and surface water elevations were collected during two groundwater sampling events over the entire site during 2006 and elevations from November 2006 are shown on Figure 5-17. The highest groundwater elevation is found near the northeast corner of the Project Site (elevation 1603 ft MSL), the northern-most portion of the iron ore tailings basin. The lowest groundwater elevation was recorded adjacent to the HTDF.

Groundwater on the Project Site is recharged from precipitation and runoff from the bedrock ridge to the north. Groundwater appears to discharge predominantly to the west and southwest. Given the close proximity of Lake Lory to the south, one would expect the groundwater in the highly permeable iron tailings to drain in that direction. While there is a component of flow toward Lake Lory, the levee around the perimeter of the iron ore tailings basin appears to be restricting the flow of groundwater. This inference is based on the slope of the water table surface on the south and east sides of the tailings basin. This has resulted in an apparent mounding of the water table and redirection of groundwater flow to the west.

The depth to groundwater varies from less than 10 ft bgs east of the mill buildings, to greater than 30 ft bgs near the HTDF. Groundwater flow across the main portion of the Project Site is to the west and southwest, where it is captured by the wetland ponds in that area and eventually enters the Black River. However, within 1,000 ft of the HTDF, groundwater is drawn to the northwest towards the pit.

### 5.1.3 Surface Water Flow

The Project Site is situated near the drainage divide between sub-watersheds of the Escanaba River, which flows southeast into Lake Michigan. Surface water on the Project Site is limited to small, isolated wetland ponds located to the east and south of the mill buildings, including ponds situated at the south and eastern ends of the iron ore tailings basins. There are no perennial surface water streams on the Project Site. Drainage on the Project Site is predominantly controlled by man-made features such as drainage trenches, constructed to minimize the time storm water runoff is on site and its contact with pyritic material that may contribute contaminants to the water. Surface water generally moves from north to south across the site, entering a tributary of the Black River. The HTDF drains to the north toward the Middle Branch of the Escanaba River.

## 5.2 Soil Analytical Results

Results from the 2006 soil sampling were compared to R 299.5746, Generic Soil Clean-Up Criteria for Residential and Commercial I Categories. In this table, the DWPC are generally the most conservative criteria. Direct contact criteria were used in specific areas, where applicable. Groundwater Surface Water Interface Protection Criteria (GSIPC) are examined later in this document in the context of examining recent groundwater quality data and stream sediment quality data. TCLP and SPLP concentrations were exceeded in several samples. Exceedances of these criteria were evaluated and are presented in Table 5-1 and summarized by occurrence below. Complete, tabulated analytical results for soil samples can be found in Appendix D-1. Figures showing the locations of these exceedances by parameter are presented in Figures 5-18 through 5-41. Appendix D-2 provides the full laboratory analytical reports. The following sections discuss the occurrence of VOCs, inorganics and metals in soil that exceed these criteria.

### 5.2.1 Volatile Organic Compounds and Polynuclear Aromatic Hydrocarbons

VOCs were detected in concentrations that exceed DWPC in two separate areas on the Project Site. These areas include: the storm water outfall and the vehicle maintenance shop area. These data are visually presented on Figures 5-18 through 5-22. Polynuclear aromatic hydrocarbon (PAHs) were detected in several soil samples but at concentrations below DWPC. The distribution of these PAHs (naphthalene, anthracene and phenanthrene) occurrences at the site are shown on Figures 5-22 through 5-24.

Several VOC parameters were detected in soils that exceed the DWPC at the storm water outfall (HA-2). Laboratory results at these two locations are summarized below:

#### Storm Water Outfall

Parameter	Units	HA-2	HA-2 (DUP)	HA-3	Drinking Water Protection Criteria
1,2,4-Trimethylbenzene	ug/kg	35000	15000	<23	2100
1,3,5-Trimethylbenzene	ug/kg	27000	11000	<11	1800
n-Propylbenzene	ug/kg	2500	1000	<12	1600
s-Butylbenzene	ug/kg	2300	880	<9.7	1600

One VOC parameter was detected in soil in the vicinity of the maintenance building that exceeded the DWPC. Three other compounds showed elevated concentrations, but were below the DWPC. Laboratory results at this location are summarized below:

### Maintenance Shop Area

Parameter	Units	KSB 4-4	Drinking Water Protection Criteria
1,2,4-Trimethylbenzene	ug/kg	5600	2100
1,3,5-Trimethylbenzene	ug/kg	1600	1800
n-Propylbenzene	ug/kg	660	1600
s-Butylbenzene	ug/kg	520	1600

These results are somewhat consistent with the historical soil data discussed in Section 3. While exceedances were not detected in soil samples collected in the past, elevated detection limits for the VOC parameters that were analyzed, suggested elevated concentrations of VOCs were historically present in the soil in this area.

### 5.2.2 Inorganics

#### Cyanide

Cyanide was detected above the DWPC at two out of 87 locations tested in the Fall of 2006. One location is in the area of the buried pyrite and the other location is near the eastern side of the pyrite stockpile area. Results are summarized in Table 5-1. The soil exceedance results at the two locations (Figure 5-25) are summarized below:

Parameter	Units	KSB-16	KSB-18	KSB-18 (dup)	Drinking Water Protection Criteria
Cyanide	mg/kg	37	14	12	4

mg/kg – milligrams/kilogram

There is very limited historical data for cyanide as described in Section 3. The widespread testing for cyanide completed in this investigation indicates the presence of cyanide at this site is quite limited.

### 5.2.3 Metals

Data summarizing metal content in soils is provided in Figures 5-26 through 5-41 and Table 5-1. Aluminum, cobalt, iron, manganese, antimony, arsenic, boron, lithium, magnesium, molybdenum, nickel, selenium, silver, and thallium were detected on site in 2006 at concentrations that exceed the DWPC. The exceedances of DWPC for boron, magnesium, nickel, selenium, silver and thallium were spatially limited. Lead exceeded the DCC. Soil samples collected in the area of the Mill exceeded acceptable SPLP concentrations for barium, cadmium, chromium and lead (KMW-2, KSB-7, KSB-15, KSB-16, KSB-18, KSB-19, SB-618 and SB-634). SPLP concentrations were also exceeded lead in the buried pyrite trench area (KMW-6, KMW-6A). The following section summarizes these findings.

### Aluminum, Cobalt, Iron and Manganese

Aluminum, cobalt, iron, and manganese were present in every soil sample collected on site in 2006 at concentrations that exceed the DWPC. There is no historical data for aluminum or cobalt in other areas across the site and very little historical data for iron and manganese. Historical data for iron and manganese were also above the DWPC. Results are summarized in Table 5-1 and Figures 5-26 through 5-29. Soil exceedances are summarized below by concentration ranges for these metals.

Parameter	Units	2006 Concentration Ranges	Drinking Water Protection Criteria
Aluminum	mg/kg	1100 - 21000	1
Cobalt	mg/kg	1.8 - 260	0.8
Iron	mg/kg	7690 - 200000	6
manganese	mg/kg	33 - 7830	1

### Antimony

Antimony was detected above the DWPC at one-third (22 out of 83) of the locations tested in the Fall of 2006. Antimony exceedances occurred throughout most of the Mill, in the area of the buried pyrite, around the maintenance shop, in the area of the pyrite stockpile and in the western central part of the iron ore tailings basin south. Results are summarized in Table 5-1 and Figure 5-30.

### Arsenic

Arsenic was detected above the DWPC at one-third (24 out of 83) of the locations tested in the Fall of 2006. Arsenic exceedances predominantly occurred in the area of the buried pyrite across the Mill and with limited occurrences in the iron ore tailings basin. These data are consistent with historical data for arsenic in soil discussed in Section 3. Results are summarized in Table 5-1 and Figure 5-31.

### Boron

Boron was detected above the DWPC at 4 locations tested in the Fall of 2006. All four exceedances were around the maintenance shop. Results are summarized in Table 5-1 and Figure 5-32. Soil exceedances are summarized below:

Parameter	Units	KSB-1	KSB-3	KSB-4	KSB-7	Drinking Water Protection Criteria
Boron	mg/kg	12	12	13	13.1	10

### Lithium

Lithium was detected above the DWPC at 63 out of 83 locations tested in the Fall of 2006. Lithium exceedances occurred throughout most of the Mill, in the area of the buried pyrite, around the maintenance shop and other mill buildings, in the area of the pyrite stockpile and in the iron ore tailings basin south. Results are summarized in Table 5-1 and Figure 5-33.

### Magnesium

Magnesium was detected above the DWPC at 5 out of 83 locations tested in the Fall of 2006 in the area of the buried pyrite, around the maintenance building, and near the pyrite AST. Results are summarized in Table 5-1 and Figure 5-34. Soil exceedances are summarized below:

Parameter	Units	KSB-1	KSB-3	KSB-4	KSB-14	KSB-16	Drinking Water Protection Criteria
Magnesium	mg/kg	13000	13000	14000	12700	10000	8000

These data are consistent with the historical data discussed in Section 3.

### Molybdenum

Molybdenum was detected above the DWPC at 15 out of 83 locations tested in the Fall 2006. Molybdenum exceedances occurred throughout most of the Humboldt Mill site, in the area of the buried pyrite, near the maintenance shop, near the pyrite AST, in the area of the pyrite stockpile, and in three locations in the iron ore tailings basin south. Results are summarized in Table 5-1 and Figure 5-35.

### Other Metals in Soil

In addition to the primary metals discussed above; nickel, selenium, silver, and thallium were detected above the DWPC at a few locations. Lead exceeded the DCC at KMW-6/6A. Results are summarized in Table 5-1 and Figure 5-36 through 5-40. Zinc (Figure 5-41) was not detected in any soil samples at concentrations that exceed the DWPC. Soil exceedances and results at these locations are summarized below:

Parameter	Units	KSB-5	KSB-7	KSB-8	KSB-13	KSB-16	KMW-6	KMW-6A	Drinking Water Protection Criteria
Lead	mg/kg	9.2	9.4	110	282	330	889	12000	400 <sup>1</sup>
Nickel	mg/kg	22	104	66	223	740	29.5	14	100
Selenium	mg/kg	3.2	0.35 J	0.95	3	6.2	<0.27 U	0.3	4
Silver <sup>2</sup>	mg/kg	1.4	0.23	9.3	17	36	0.25	0.037 B	4.5
Thallium	mg/kg	3.3	0.3	0.0027 B	0.0046 J	0.0069 B	<0.054 U	0.011 B	2.3

<sup>1</sup>Direct contact criteria

<sup>2</sup>Silver also exceeded DWPC at HA-1BP collected in June 2006

Exceedances of nickel, lead and silver occurred primarily in the area of the buried pyrite trench. Additionally, there was one exceedance of nickel and silver at KSB-8 near the pyrite AST. Exceedances of selenium occurred only in the area of the buried pyrite. The one exceedance of thallium is near the maintenance shop.

Very little historical data exist for nickel, selenium and silver and no historical data exist for thallium. Current data for nickel, lead and silver are consistent with historical data described in Section 3.

### 5.3 Groundwater Analytical Results

Results from the November 2006 groundwater sampling were compared to the R 299.5744 Groundwater Residential & Commercial Clean-Up Criteria. DWC are generally the most conservative groundwater clean-up levels. Exceedances of these criteria were evaluated and are presented in Table 5-2 and summarized below. GSIPC are addressed later in this document in Section 5.4.2. Manganese and iron are not included in Table 5-2 as both metals exceed the drinking water standard in most monitoring wells on site. Figures showing the locations of these exceedances by parameter are presented in Figures 5-42 through 5-59.

The groundwater sampling reports are provided in Appendix E. The field reports are presented in Appendix E-1. A table summarizing the groundwater analytical results relative to DWC is presented in Appendix E-2. The laboratory reports are provided in Appendix E-3. The following sections discuss the occurrence of VOCs, inorganics, and metals that are above the DWC.

#### 5.3.1 Volatile Organic Compounds

Benzene, ethylbenzene, and xylenes were detected in groundwater monitoring wells MW-104 and MW-5 located in the area of the maintenance shop waste oil UST (Figures 5-42 through 5-44). Results at these two locations are summarized below:

Parameter	Units	MW-104	MW-5	Drinking Water Criteria
Benzene	ug/L	<0.65 J	10	5
Ethylbenzene	ug/L	3.2	90	74
Xylenes	ug/L	27	1400	280

ug/l – micrograms/liter

MW-5 is the only monitoring well with VOCs detected at or above the DWC. In well MW-104 detections of ethylbenzene and xylenes were below the standard and benzene was detected at a level below the method detection limit.

These results are consistent with the historical groundwater data discussed in Section 3. Contaminant concentrations have decreased over time in both monitoring wells indicating that natural attenuation of the VOCs is occurring. In the past, contaminant concentrations in MW-104 exceeded the DWC. The recent 2006 data show the levels of VOCs in MW-104 have decreased to below the DWC. No other VOCs were detected during the November 2006 sampling event.

#### 5.3.2 Inorganics

Inorganic data is summarized in Table 5-2 and Appendix E-2.

##### Nitrogen/Ammonia

Nitrogen/Ammonia was detected below the DWC in a majority of the groundwater monitoring wells. However, ammonia was detected above the DWC in groundwater only in monitoring wells MW-5, located in the vicinity of the maintenance shop waste oil release, and MW-11

located in the pyrite stockpile area (Figure 5-45). Results at these two locations are summarized below:

Parameter	Units	MW-5	MW-11	Drinking Water Criteria
Nitrogen/Ammonia	mg/L	19	22	10

mg/l – milligrams/liter

These results are consistent with historical data for MW-11 discussed in Section 3. Nitrogen/Ammonia was not detected historically at MW-5. Contaminant concentrations have decreased in MW-11 but have increased at MW-5 relative to historical data.

#### **Sulfate**

Sulfate was detected below the DWC in most of the monitoring well locations but was detected above the DWC at KMW-6, KMW-9P, KMW-7 located in the area of the buried pyrite, and MW-102 located in the area of the pyrite AST (Figure 5-46). Results at these four locations are summarized below:

Parameter	Units	KMW-6	KMW-7	KMW-9P	MW-102	Drinking Water Criteria
Sulfate	mg/L	360	750	850	13,000	250

Historically sulfate has been detected above the DWC in the pyrite stockpile area, in the area of the maintenance shop, and near the pyrite AST as discussed in Section 3. There is no historical sulfate data in the area of the buried pyrite. Based on the November 2006 groundwater results there is no longer an occurrence of sulfate above the DWC in the pyrite stockpile area and the maintenance shop area.

### **5.3.3 Metals**

Groundwater quality data for metals is summarized in Table 5-2 and Appendix E-2 and is presented graphically on Figures 5-47 through 5-59.

#### **Iron and Manganese**

Iron and manganese occur in groundwater at every monitoring well location across the site (Figures 5-47 and 5-48). Iron occurs above the DWC in all monitoring wells except one, MW-605. Manganese is present above the standard in all monitoring wells. This is consistent with historical data from the area.

#### **Aluminum**

Aluminum occurs in groundwater at concentrations that are above the DWC in the area of the maintenance shop, in the pyrite stockpile area, in the area of the pyrite AST, and in the area of the fuel oil AST. Results at these locations are summarized below and in Figure 5-49:

Parameter	Units	KMW-1	MW-5	MW-11	MW-102	MW-104	MW-601	PW-1	PW-4	Drinking Water Criteria
Aluminum	ug/L	62	360	430	400,000	80	58	130	230	50

No historical data exists for aluminum.

### Arsenic

Arsenic is present in groundwater at concentrations above the DWC at KMW-6 located in the area of the buried pyrite trench; MW-5, MW-104, and PW-4 in the area of the maintenance shop; MW-9 and KMW-2 in the area of the office and diesel and gas USTs; MW-11, MW-12, MW-101 and MW-103 in the pyrite stockpile area; MW-601 near the fuel oil AST and MW-102 near the pyrite AST. Exceedance results at these locations are summarized below and on Figure 5-50:

Parameter	Units	KMW-2	KMW-6	MW-5	MW-9	MW-11	MW-12	Drinking Water Criteria
Arsenic	ug/L	24	12	160	29	18	10	10

Parameter	Units	MW-101	MW-102	MW-103	MW-104	MW-601	PW-4	Drinking Water Criteria
Arsenic	ug/L	31	5,600	14	28	26	93	10

The November 2006 occurrences of arsenic in groundwater are generally consistent with the historical occurrence of arsenic discussed in Section 3.

### Cobalt

Cobalt is present in groundwater at concentrations above the DWC in monitoring wells KMW-5 and KMW-7 in the area of the buried pyrite and in well MW-102 located near the pyrite AST. Results at these three locations are summarized below and on Figure 5-51.

Parameter	Units	KMW-5	KMW-7	MW-102	Drinking Water Criteria
Cobalt	ug/L	67	120	6,400	40

### Vanadium

Vanadium is present in groundwater at concentrations that exceed the DWC at KMW-7 located south of the buried pyrite trench; MW-5, MW-104, PW-1, and PW-4 in the area of the maintenance shop; MW-102 near the pyrite AST, MW-11 in the pyrite stockpile area and MW-601 in the area of the fuel oil AST. Results at these locations are summarized below and on Figure 5-52.

Parameter	Units	KMW-7	MW-5	MW-11	MW-102	Groundwater-Drinking Water Criteria
Vanadium	ug/L	4.8	21	16	220	4.5



Parameter	Units	MW-104	MW-601	PW-1	PW-4	Groundwater- Drinking Water Criteria
Vanadium	ug/L	4.6	5	5.2	11	4.5

No historical data exists for vanadium.

#### Other Metals in Groundwater

In addition to the metals listed above the following metals occur in groundwater at concentrations that exceed the DWC only at monitoring well MW-102, located near the pyrite AST (see Figures 5-53 through 5-59):

Parameter	Units	MW-102	Drinking Water Standard
Beryllium	ug/L	29	4
Cadmium	ug/L	49	5
Chromium	ug/L	8000	100
Copper	ug/L	10000	1000
Lithium	ug/L	450	170
Nickel	ug/L	14000	100
Zinc	ug/L	5800	2400

No historical data exists for beryllium or lithium. The other data are consistent with historical groundwater data discussed in Section 3.

## 5.4 Surface Water Analytical Results

Surface water samples were collected in August 2006 and November 2006 using the procedure described in Section 4. Results from these sampling events were compared to the lowest value of the Rule 57 Water Quality Criteria. Exceedances of these criteria were evaluated and are presented in Table 5-3 and summarized below.

The surface water sampling reports and results are provided in Appendix F. The field reports are presented in Appendix F-1. A summary tables containing surface water field and analytical results are presented in Appendix F-2. A table containing the sediment analytical results from samples collected at surface water sample locations are presented in Appendix F-3. The analytical laboratory reports are provided in Appendix F-4. Figures showing the locations of the surface water exceedances by parameter are presented in Figures 5-60 through 5-65 for the October sampling event.

Exceedances of manganese, nickel, silver, mercury and zinc were detected. The following section discusses these exceedances.

### 5.4.1 Metal Concentrations in Surface Water

Manganese was detected above the final chronic value set forth R 323.1057 at Lake Lory in August 2006. Mercury was detected above the wildlife value in Lake Lory, the Black River and

the Middle Branch of the Escanaba River in August 2006 and at only two locations in October 2006.

Nickel exceeded the final chronic value only at station HMP-001H in August 2006. The suffix "E" indicates the sample was collected above the thermocline, whereas the suffix "H" indicates the sample was collected below the thermocline. Silver exceeded the final chronic value only at HTP-002 in August 2006.

Zinc exceeded the aquatic maximum value at WBR-001 in October 2006.

#### **5.4.2 Sedimentation Evaluation and Groundwater Surface Water Interface Protection Criteria**

The probable effect concentration (PEC) or EPA, Region 5, RCRA Ecological Screening Levels (ESL) were evaluated relative to the sediment quality samples collected in August 2006. The GSIPC were evaluated relative to groundwater quality data collected in June and November 2006.

##### **5.4.2.1 Sediment Evaluation**

During the August surface water sampling event, grab samples of sediment were collected at the surface water sample stations. These results were compared to the PEC (or ESL when a PEC was not available). A summary of the exceedances are provided as Table 5-4 and figures showing the locations of exceedances are presented as Figure 5-66 to 5-72.

Arsenic, chromium, copper, cobalt, lead, nickel, and silver were detected above the PEC or ESL in August. Chromium, cobalt copper and lead were only detected above the criteria at HMP-001 located within the HTDF. Arsenic, nickel, and silver were detected above the criteria at multiple locations throughout the project site. No criteria were exceeded at HTP-002, MBR-001, MER-001, MER-002, MER-003, WBR-001, WBR-002 or WBR-003.

##### **5.4.2.2 Groundwater Surface Water Interface Protection Criteria - Groundwater**

Table 5-5 summarizes 2006 groundwater quality relative to GSIPC. The table shows that a number of metals at a variety of wells exceed the GSIPC.

### **5.5 Mill Analytical Results**

#### **5.5.1 Stockpile Sampling Results**

All stockpile samples were collected by Foth during a site visit on March 28 to 30, 2006 and on June 6, 2006 and October 31, 2006 following procedures outlined in Section 4. During the site visit, numerous stockpiles were noted throughout the buildings. While some of these materials were totally contained within bins, supersacks or drums, others were stored openly on the ground or the condition of the container had caused the material to spill on the ground. Except for two of the materials, all sample locations were collected inside existing building structures. In selecting materials for sampling, the primary focus was on materials that were being stored on the ground or presented some degree of risk due the condition of the storage container.

In four instances, composite samples of loose material were collected from the floor. This was done in areas where there appeared to be no concrete floor and/or where substantial material had been spilled over the floor due to past operations. These areas are noted below and on Figure 4-3:

- ♦ Crushing Building Floor - (Map Identification [ID] Number [No.] 10)
- ♦ Concrete Mill Floor - (Map ID No. 16)
- ♦ Mill Basement Floor - (Map ID No. 11)
- ♦ Mill RR Floor - (Map ID No. 19)

Table 4-11 provides a list of materials that were included in the sampling and a short description of the nature of the material. Appendix G-1 contains the analytical methods and detection/reporting limits for each parameter. Appendix G-2 also includes field logs for all stockpile samples that were collected. Appendix G-3 is a presentation of the analytical results in a tabular format for each type of material. Appendix G-4 includes a copy of the laboratory analytical report, including COC forms. The results are compared against R 299.5744 and R 299.5746 clean-up criteria for Residential and Commercial I categories. Although industrial cleanup criteria also exist, these cleanup criteria were selected for use in this analysis because these are the appropriate baseline cleanup levels to consider when assessing baseline conditions. Given most of these materials are located inside buildings and/or in containers, it is assumed the most applicable screening level would be generic soil cleanup criteria for direct contact.

If the material has potential to affect groundwater, other generic soil cleanup criteria may be applicable, such as those for drinking water protection. This would particularly be case for samples collected from materials identified as "south storage pile A" and "leachate residue pile" (Map ID No's 1 and 2). Both of these materials are located outside.

In addition to total metals, all metals that are regulated under Resource Conservation and Recovery Act (RCRA) were analyzed for TCLP metals. Results are compared against the Environmental Protection Agency (EPA) TCLP criteria and are also provided in the table in Appendix G-3.

In general, all materials exhibit some degree of elevated metals. This is not surprising given most of these materials remain from previous facility operations. Some materials, such as the material identified as "Filter Press Floor" (Map ID No. 15), exhibited concentrations that exceeded several DCC, including total cyanide, lead, iron and arsenic. This material was found on the floor in the vicinity of one of the filter presses. Given these levels, it is possible this material remains from former gold processing operations. Stockpile samples in the crusher building exceed the direct contact criteria for aluminum (EECB-2) and arsenic (EECB-1 and EECB-3).

Multiple composite samples collected of indoor floor materials, except the concrete mill floor sample, exceeded DCC for arsenic. In addition, one of the samples (Mill Basement Floor, Map ID No. 11) also exceeded the DCC for total cyanide and lead. Given these concentrations and other analyses for the material, it is possible this latter material may be similar to the "Filter Press Floor" sample described above in that it appears to have concentrations of metals in the same general ranges. It should also be noted that one of the indoor floor materials exceeded the acceptable TCLP concentration for lead (Concrete Basement Floor, Map ID No. 16). This was

in the general area of the west portion of the mill, where numerous incoming materials appear to have been stored.

The acceptable TCLP concentration for lead was also exceeded for two additional materials. These were the materials described as "Lunch Room Slag" (Map ID No. 20) and "Gold Contact" (Map ID No. 12). The first material was a sample from two deteriorated fiber drums of fire assay waste located in the former lunch room in the mill. The second material was from a small pile of white material located in the mill basement.

The two outdoor sample locations included the "South Storage Pile A" (Map ID No. 1) and the "Leachate Residue Pile" (Map ID No. 2). The first sample was a composite of material obtained from a small storage pile located just to the south of the mill building. The second sample was a boring collected in the vicinity of the former leachate residue storage area to the immediate south of the mill building. Samples collected from these two outdoor sample locations show exceedances of several soil DWPC, including those for aluminum, antimony, arsenic, cobalt, iron, manganese and silver. The generic soil cleanup criterion for nickel was also exceeded for the south storage pile in this category. Direct contact criteria for arsenic were also exceeded for both samples.

In addition to the stockpile samples that were identified and sampled during this site visit, there are numerous other materials stored in these areas that are fully contained in drums, supersacks or bins. One material of note not sampled was located in the old crusher building in the general vicinity of Map ID No. 9. Ten steel drums were noted with a label identifying the material as "grit blast waste". The label indicated the material was considered to be a hazardous waste due to it failing TCLP for characteristics of lead and cadmium. The material was not sampled due to the fact it was sealed in a drum. The existence of these drums should be noted for future reference due to the potential regulatory ramifications.

Samples M-1, M-3, M-4 and M-5 on Figure 4-3 are located inside buildings. In assessing these samples, it is assumed that the most applicable screening level is the DCC. The exception was M-3 where the DWPC is appropriate. In addition to total metals (and cyanide for two materials), samples were analyzed for TCLP metals. Laboratory results for the solids are shown in Appendix G-3.

In general, all materials showed some degree of elevated metals. Similar to the materials described above, these materials are all derived from process materials, so this is not a surprising finding. Only three metals were found to exceed the DCC in three solid samples (M-1, M-4 and M-5): antimony, arsenic and iron.

The laboratory results for VOC analysis of Sample M-3 (water) indicate that all constituents were below detection limits (Appendix G-3).

### **5.5.2 PCB Sampling Results**

Sample results for the oil-stained area (M-2 east and M-2 west) indicates that all PCB concentrations were below cleanup levels set forth in the federal PCB Cleanup Policy described at 40 CFR 761. Total PCB concentrations for both samples were slightly elevated at 7.1 and 8.6 (microgram/100 cm<sup>2</sup>)  $\mu\text{g}/100\text{ cm}^2$ ; however both concentrations were below Federal cleanup levels for PCBs at 10  $\mu\text{g}/100\text{ cm}^2$ .

Sample results for a composite of the black oily material, at M-6, indicate total PCBs may exceed the required cleanup level. For example, Aroclor-1260 was at 270 µg/kg, Aroclor-1254 was at 490 µg/kg and Aroclor-1242 was at 560 µg/kg. Total PCBs were 1,300 µg/kg. Federal cleanup levels for a high-occupancy location without a fence or cap would be 1,000 µg/kg. However, it should be noted that these cleanup levels were targeted for sources of PCBs of 50,000 µg/kg (50 parts per million [ppm]) or greater. The policy also applies to spills of materials that occurred after May 4, 1987. Spills prior to that date are addressed on a case-by-case basis. In that it is not known what the source of this spill is or when it occurred, the more conservative cleanup standard 1,000 µg/kg is being applied. MDEQ regulations also defer to the federal standard for PCB cleanup. Therefore, it appears the federal and state cleanup criteria for this material may have been exceeded. The full set of results are summarized in Table G-3 in Appendix G-3.

### 5.5.3 Buried Pyrite Area Sampling Results

Samples from the buried pyrite area were obtained by Foth during a site visit on June 6, 2006 at the request of KEMC. The sample sites were in the buried pyrite area west of the mill buildings (Figure 4-3). A historical figure shows the pyrite area consisting of two distinct portions (Maxim, 2000). The far western portion is labeled as "concentrated pyrite material" while the section in the middle and to the east is described as "unsorted pyrite material". The figure suggests the concentrated pyrite area is much smaller than the unsorted area. Although there is not much discussion of this in the accompanying text, it is assumed this means the western portion contains material that could have higher concentrations of metals.

During the site visit on June 6, three hand auger borings were collected at the top of this area. They were identified in the field as HA-1, HA-2 and HA-3 and are labeled on Figure 4-3 and in Appendix G-3 as HA-1BP, HA-2BP and HA-3BP. HA-1BP was collected in the western portion, where higher metal concentrations may be expected to occur. HA-2BP and HA-3BP were obtained in the middle and eastern portion, which is the unsorted pyrite. After scraping off a couple inches of surface material, the auger was driven into the material about 12 to 18 inches at each location. At each location, the auger was met with considerable resistance due to the presence of rocks below the surface. This was particularly the case for HA-2BP and HA-3BP. More silt and granular material was noted in HA-1BP. At each location, brown and yellow colored material was encountered immediately, which suggests the pyrite material lies just below the surface and is not covered with a top confining layer of material. Round iron pellets were also noted as samples were being obtained.

All samples were analyzed for a suite of metals. Analyses included total metals, TCLP and SPLP. RCRA metals included arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver. Although copper and nickel do not have specified RCRA TCLP levels, TCLP and SPLP analyses were also performed on these metals, due to their importance to the overall project. Percent solids were also analyzed. In general, the total metals concentrations were significantly higher in HA-1BP when compared to results from HA-2BP and HA-3BP. This was particularly the case for arsenic, cadmium, chromium, copper, lead, nickel and silver. Total metals were also elevated above state-wide background levels for most of the samples. Arsenic and chromium appear to exceed state direct contact criteria for generic soil cleanup levels for all three samples and nickel and silver exceed DWC in HA-1BP. All samples passed TCLP and SPLP analyses by significant margins. A comparison of these data against state cleanup criteria

is presented in Appendix G-3. A copy of the laboratory report and chain-of-custody form is provided in Appendix G-4.

Although this set of samples appears to pass all leach tests that were performed, it should be noted that this sampling technique only allowed collection of samples near the top of the pyrite storage area. The total volume of the buried pyrite area is much deeper and it is possible there could be higher concentrations of metals further down in the material. This could include material that could have higher leaching potential.

The results of this sampling effort can be compared to past samples that have been collected at the site. Maxim (2000) provided the results of buried pyrite samples collected in July 1998 (Maxim, 2000, see Tables 3a and 3b). These all appear to be obtained from test pits at intervals ranging from 2 to 5 ft below the surface. A total of 10 sample locations were identified. Results from this time period indicate that while metals were elevated in many of the samples, all samples passed SPLP and TCLP tests.

It should also be noted that visual observations of this area indicate sparse vegetation across the top of the pyrite area when compared to other parts of the site. Brownish-orange stains were observed on the access road directly below the pyrite area, which suggest runoff from this area is ongoing. Exposed soil on the other side of the road from the pyrite area also has sparse vegetation, suggesting some impact from runoff at the pyrite area.

## **5.6 Asbestos and Lead Inspection Results**

As a result of visual observations made during the Phase I ESA and information from previous Phase I ESAs conducted at the site, KEMC authorized Foth to retain Legend Technical Services, Inc. to conduct a full asbestos and lead evaluation inside buildings at the site. Both evaluations were conducted on August 15 and 16, 2006.

Results of the asbestos survey showed that asbestos-containing material was identified in several different types of materials, including pipe insulation, boiler insulation, condensate tank insulation, boiler door refractory, duct seam insulation, boiler gasket, and window glaze. In addition, asbestos was detected in floor and ceiling tiles in office areas at the facility.

Results of the lead survey indicated that lead based paint in excess of regulatory the limit of 1 mg/cm<sup>2</sup> was found on selected painted material, concrete, concrete block and wood surfaces throughout the facility. The regulatory limit is the federal definition according to the Federal Department of Housing and Urban Development (HUD). This same definition is also used by the State of Michigan.

More details are provided in the complete asbestos survey report (Appendix G-5) and the complete lead survey report (Appendix G-6).

## 6. Conclusions

Investigations of the soil, groundwater, surface water and other materials on the Project Site have confirmed the presence of hazardous substances related to some of the RECs and not with others identified in the Phase I ESA. Considering the Project Site is a former iron ore processing facility, adjacent to an iron mine, many of the metals identified at the site during this investigation were primary constituents of the iron ore. In addition to iron, manganese and aluminum which are common iron ore constituents, cobalt and lithium can be found in nearly every soil sample. Arsenic, antimony and molybdenum are also common across the entire Project Site. Although there is no published mineral record for the former Humboldt Mine, it is generally accepted among local geologists that the geochemistry of the former Humboldt Mine and the neighboring Champion Mine is unique to the Marquette Range. The high concentration of these metals likely represents an elevated background for this area and, with the exception of antimony and arsenic, will not be considered further in regard to the RECs.

Gold ore from the Ropes Mine, near Ishpeming was processed on the Project Site from 1985 through 1990. This activity brought another suite of metals and other potentially hazardous substances to the Project Site, although the possible area of impact would be smaller than that covered by the earlier iron ore processing. Antimony and arsenic found in the buried pyrite trench suggest they were a component of the gold mining process.

In general the soil investigation of the Phase II ESA has shown that RECs in the vicinity of the Shop Office and Mill area, the fuel oil AST, the septic drain field and stormwater outfall, the buried pyrite and isolated areas in the vicinity of the pyrite stockpile have concentrations of hazardous substances that exceed Part 201 criteria. The groundwater investigation has shown that contaminants of concern are isolated and limited to the area around the mill and to a lesser extent, in the vicinity of the buried pyrite. However, it should be noted that in many cases, contaminant concentrations in soil and groundwater barely exceed their respective criteria.

Samples collected in the mill buildings indicate relatively high concentrations of a variety of hazardous compounds. While this was not entirely unexpected, considering the previous uses of this facility, this investigation has shown the presence of PCBs, metals and other inorganic compounds that will have to be containerized and properly disposed.

Surface water is not abundant on the subject site. Surface water generally follows man-made ditches that drain into a natural drainage with associated wetlands that have been modified by the construction of the former Humboldt Mill. The ditches were constructed by Callahan and CCI to mitigate the impact of stormwater runoff. Historic exceedances of contaminants of concern have not been duplicated because water is only found in those locations during spring runoff and heavy precipitation events. It should be noted that most of the perceived source material for contaminated runoff, the pyritic stockpile, has been removed from the original location south of the Mill.

The findings and recommendations of this Phase II ESA are provided in Sections 6.1 through 6.12.

## 6.1 Shop Office Area

- ◆ Based on the historic investigations conducted in the office diesel and gas USTs area and data obtained from this investigation, the leaking UST site has been remediated. Should KEMC acquire the Project Site, they could file the appropriate paperwork to request case closure.
- ◆ The hydrocarbon release from the maintenance shop waste oil release area has not been remediated to the extent that closure could be granted. Should KEMC acquire the Project Site, they should propose case closure to the MDEQ by either excavating the petroleum-impacted soil or covering it with an impermeable asphalt cap. In either case groundwater monitoring may be required to demonstrate that contaminant concentration trends are stable or decreasing.
- ◆ Oil stains were noted on the vehicle maintenance shop floor and the presence of floor drains and cracks were observed in the floor. While these conditions may have contributed to the nearby petroleum release, the floor drains have been sealed. Should KEMC acquire the Project Site, the floor could be sealed as well.
- ◆ Containers of lab assay waste were noted in the lunchroom. This material fails TCLP for lead. Rainwater has leaked in to the area and caused fiber drums to deteriorate and cause staining on the floor. Should KEMC acquire the Project Site, this material would have to be containerized and properly disposed.

## 6.2 Mill Buildings

- ◆ Oil staining observed on the floor in the motor control centers in the mill building was shown to contain PCBs. Should KEMC acquire the Project Site, this material would have to be sealed and/or removed and properly disposed of.
- ◆ An AST located inside the building, along the east wall reportedly contained water with a layer of oil. When a sample was collected from this AST, no oil was found and the results of the laboratory analysis showed no detection of VOCs.
- ◆ A brown, congealed material noted on the outside walls of one of the interior offices in the mill building, between the motor control centers was shown to contain PCBs in excess of EPA's PCB Cleanup Policy. Should KEMC acquire the Project Site, this material would have to be removed and properly disposed.
- ◆ The AST located outside of the southeast corner of the mill building has released finely ground pyrite material on the lower floor inside the mill that has spread to the south wall. This material contains high concentrations of arsenic and iron. Should KEMC acquire the Project Site, this material would have to be containerized and properly disposed.
- ◆ There are numerous piles or open containers of former process materials stored at several locations within the building. Other materials include remaining mill reagents and laboratory chemicals. It is believed most of these materials will be managed by selling the materials directly to an interested party, recycling or disposal at an appropriate facility. Should KEMC acquire the Project Site, this material would have to be properly



managed and removed from the site.

- ♦ There is an accumulation of debris both within the mill building complex and around the perimeter. Debris includes such items as used equipment, metal debris, empty steel drums, refractory material and insulation. Should KEMC acquire the Project Site, this material may need to be further assessed and possibly removed from the site.

### **6.3 Fuel Oil AST**

Soil samples from beneath the former AST location showed no petroleum compound concentrations that exceed DWPC. A groundwater sample collected near the AST showed no petroleum compound concentrations that exceed DWPC.

### **6.4 Pyrite Stockpile Area**

- ♦ Soil samples collected in this area show isolated impacts of cyanide, arsenic, silver and antimony are still present.
- ♦ With the exception of ubiquitously occurring metals and arsenic, high concentrations of dissolved metals are not common in groundwater samples beneath this area or in the downgradient direction which suggests that the remaining, limited source material is not providing a significant source to be transported to the groundwater.
- ♦ The limited surface water samples collected in this area do not indicate any significant impact from contaminants of concern other than high background metals.

### **6.5 Buried Pyrite and Truck Scale Area**

- ♦ Soil samples collected in this area indicate that high concentrations of virtually all metals analyzed are still present above DWPC. Groundwater samples collected to the north and south of this area indicate high concentrations of sulfate, indicating the degradation of the primary pyrite. Arsenic, vanadium and cobalt were detected above DWPC.
- ♦ It was noted during the Phase I ESA that yellow-orange staining of the paved roadway adjacent to the pyrite trench has occurred. Some of the vegetation on the other side of the roadway appears to be stressed. High concentrations of sulfate in groundwater south of this staining suggests that high-sulfur surface water runoff from the buried pyrite trench area is migrating to the south and impacting both vegetation and groundwater. Should KEMC acquire the Project Site, the material in the buried pyrite trench could be excavated and properly disposed to eliminate this contamination source.
- ♦ Elevated metals concentrations that exceed the DWPC were also noted in historic soil samples in the vicinity of the former truck scale area. According to Maxim (2000), the soil at the scale area was excavated and disposed at a local landfill, but no documentation was presented to support this action. Due to extremely difficult drilling conditions in this area, soil and groundwater samples were not collected during the Phase II ESA. It should be noted that no DWPC exceedances were detected in the downgradient monitoring well, indicating any remaining metals in the soil at the scale area are not contributing to groundwater impacts.

## **6.6 Septic Drainfield and Stormwater Outfall**

During the field inspection, a storm water or process water outfall was identified which formerly discharged into a wetland adjacent to the septic field. Based on laboratory analysis, soil samples collected in this area contain several petroleum related compounds that exceed DWPC. Should KEMC acquire the Project Site, this material could be excavated and properly disposed to eliminate this contamination source.

## **6.7 Iron Ore Tailings Basins**

Two large iron ore tailings storage facilities are located approximately 1,400 ft southeast of the mill buildings. Laboratory analysis of the tailings indicted high concentrations of iron, manganese, aluminum, cobalt and lithium in samples above the DWPC. These metals are believed to represent the primary metal assemblage in the iron ore from the former Humboldt Mine. Antimony, arsenic, molybdenum were also detected in a number of tailings samples that exceed DWPC. Laboratory analysis of groundwater in the iron ore tailings facility did not detect any exceedances of DWPC other than for iron and manganese, indicating the metals in the tailings are not leaching to groundwater in significant quantities. Note that these tailings basins are off site from the subject site.

## **6.8 Electrical Substation**

Evidence of spills and/or leaks outside the building were not observed, therefore no samples were collected. Although the building was locked, KEMC may want to verify that PCBs are not present in electrical equipment inside the building if it should acquire the property.

## **6.9 PCB Transformers**

The Project Site formerly had several PCB containing transformers on-site that were removed and disposed. Previous sampling has shown evidence of PCB contamination in three areas where transformers were located. The location of these transformers could not be verified, so no additional samples could be collected. Should KEMC acquire the Project Site, any oil product or staining could be fully characterized prior to cleanup or removal. If PCBs were detected the material should be containerized and properly disposed.

## **6.10 Crusher Building**

Should KEMC acquire the Project Site, the grit blast waste in the crusher building would need to be characterized and properly disposed.

There are numerous piles and other closed containers of process material stored within the building. Should KEMC acquire the Project Site, this material would need to be either recycled, sold to an interested party or containerized and properly disposed.

## **6.11 Iron Ore Concentrate**

There are two piles of iron ore concentrate located south of the mill buildings. Should KEMC acquire the Project Site, this material may have to be properly disposed. It is also recommended that the iron pellets that form a consistent cover over much of the site be removed.

## **6.12 Asbestos and Lead Assessment**

As a result of visual observations made during the Phase I ESA and information from previous Phase I ESAs conducted at the site, KEMC authorized Foth to retain an asbestos assessment contractor to conduct an asbestos evaluation inside buildings at the site. ACMs were observed and verified by a certified asbestos assessment contractor. Should KEMC acquire the Project Site, the asbestos may need to be removed, containerized and properly disposed.

Based on the findings of a lead-based paint assessment, lead-based paint is present inside the buildings. Should KEMC acquire the Project Site, this paint may need to be removed, containerized and properly disposed.

## 7. References

- Bouwer H. and R.C. Rice. 1989. *The Bouwer – Rice Slug Test – An Update, Groundwater, Vol 27, No. 3, 1989, pp. 304-309*
- Callahan Mining Corporation. 1995. *Ropes Closure Document.*
- Callahan Mining Corporation. 1996. *Characterization and Remedial Alternatives for Groundwater - Humboldt Mill Facilities.*
- Cannon, W.F. 1975. *Bedrock Geologic Map of the Republic Quadrangle, Marquette County, Michigan, USGS –Map I-862.*
- Foth Infrastructure & Environment, LLC. 2007. *Humboldt Mill Project – Phase I Environmental Site Assessment.*
- MacDonald, D.D., C.G. Ingersoll and T.A. Berger. 2000. *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems.* Archives of Environmental Contamination and Toxicology. Volume 39, pg 20-31.
- Maxim Technologies, Inc. 1999. *Qualifications of the Humboldt Millsite, Michigan, for Closure under Part 201.*
- Maxim Technologies, Inc. 2000. *Remedial Action Plan for Closure of the Humboldt Millsite Michigan under Part 201.*
- Michigan Department of Environmental Quality. October 24, 2004. *MDEQ RRD Operational Memo No. 2 Attachment 5 - Sampling and Analysis, Collection of Samples for Comparison to Generic Criteria.*
- NAFAC DM-7.1. 1982. *Soil Mechanics Design Manual 7.1 Department of the Navy Naval Facilities Engineering Command*
- North Jackson Company. 2004. *Eagle Project – Hydraulic Assessments Standard Operating Procedures Manual and Quality Assurance Project Plan (previously submitted to MDEQ).*
- Sowers, George F. 1979. *Introductory Soil Mechanics and Foundations: Geotechnical Engineering*
- Sundberg, Carlson and Associate, Inc. 1996. *Baseline Environmental Assessment - Volumes 1 - 3.*
- Sundberg, Carlson and Associate, Inc. 1996. *Baseline Environmental Assessment - Vol 2 of 3 - Investigative Report (Attachment B to 1996 Baseline Environmental Assessment).*

Sundberg, Carlson and Associate, Inc. 1996. *Baseline Environmental Assessment - Vol 3 of 3 - Historical Environmental Documentation (Attachment C to Baseline Environmental Assessment)*.

Sundberg, Carlson and Associate, Inc. 1996. *Leaking Underground Storage Tank - Closure Report*.

Sundberg, Carlson and Associate, Inc. 1996. *Phase I - Environmental Site Assessment - Former Ropes Milling Plant Property (Attachment A to Baseline Environmental Assessment, included in Vol 1 of 3)*.

Sundberg, Carlson and Associate, Inc. 1992. *Ropes Mill Facility - Preliminary Hydrogeological Investigation*.

Titan Environmental Corporation. 1997. *Ropes Mill Site Closure - Phase II-DRAFT*.

United States Environmental Protection Agency. August 22, 2003. *USEPA, Region 5, Ecological Screening Levels*.